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THE ELECTRIC FAN MOTOR.

It is hard to conceive the condition of our immediate ancestors who were denied the blessings of the electric fan. Probably nothing that has been invented has proven so useful in amelioration to the general discomfort of humanity in hot weather, and so tended to reduce profanity and perspiration as this pleasing device. It appears to have been invented, or perhaps we might better say discovered, in this country about fourteen years ago, and already it has taken its place as an essential instrument of civilization.

From many points of view the electric fan motor is an important piece of mechanism. Not only has a large trade grown up based upon its manufacture and sale, but it has made itself an important addition to the custom of central stations supplying electricity for sale to the public. It happens that in the Summer, when the fan motor is most in use, the electric light, by reason of short evenings and the general closing of places of business at an early hour, is little used, so that the average output of the station is to some degree maintained by the consumption of current for fan purposes. The small fans also provide an excellent day load for stations, and considerable revenue has accrued to electric light companies from their widespread introduction.

It is interesting to notice the high perfection which these machines have attained, as is set forth in considerable detail in succeeding pages of this number. Of great interest, also, is Mr. Henshaw's account of the early history of electric fans, and the way in which they came to constitute an important line of manufacturing business for electric companies.

Another feature of interest connected with electric fans is that they are purely American, both by right of invention and of use. It is a somewhat singular fact that their use in other countries and in hot climates has been so limited, but it is believed that at least the beginning of a considerable export trade in this class of merchandise has been made, and that from now on increasing and satisfactory numbers of these instruments will be shipped abroad from our American ports. A modern development of the fan, which was primarily designed for ventilation and for moving air or the creation of small breezes, is the application to the fan mechanism of cooling and heating devices, so that an actual change in the temperature of the air may be made. In this way certain electric fan installations have been made lately by which the triple purpose of cooling in Summer, heating in Winter, and ventilating the rooms in which the apparatus is installed at all times, is accomplished.

A glance at succeeding pages will give some idea of the magnitude to which the industry of electric fan making in the United States has grown, and of the care in design and manufacture that has been expended upon these small but useful and comfort-giving appliances.

THE CENTRAL STATION AND THE CUSTOMER.

In these columns recently we asked the question "What does the electric light station sell?" and in endeavoring to find a proper reply to this, and to the cognate question "What ought the electric light station to sell?" a field for very interesting speculation and discussion is opened.

If one looks at the subject solely from the point of view of the manager of the central station he observes at once that the business, so far as the station itself is concerned, is strictly a manufacturing enterprise not dissimilar in most respects from other lines of effort in which crude materials are taken in and a finished product produced. The station absorbs coal, water, oil, supply and renewal parts, lamps, carbons and labor, and its immediate output is electric current. Ever since the business of electric lighting has been upon a fair commercial basis, and since the question of metering consumers' supplies has been discussed, it has been more or less tacitly assumed that the business of the station ended with the production of the utmost possible amount of electrical energy of an available type from the least quantity of material and labor, and the sale of this product to the consumer. To this end meters have been made to read in electrical units, and the whole commerce of the electric light station ends when current in the quantity required is supplied to the consumers' mains, and when the bill duly rendered for kilo-

watt-hours, or other units, is presented and collected.

What the customer is buying, however, in nine cases out of ten, is light or motive power. In his premises are installed certain lamps and motors, and he pays the central-station company its bill for maintaining these devices in proper operating order, and supplying to them the necessary current that their functions require, and with him the business transaction is ended when he receives such light or motive power as he wishes and pays for the same what he considers a reasonable amount. It will be observed, however, that the transaction involves the translation of electrical energy into such utilities as the customer demands, and that while he gets one thing he pays for another. Now, this is a perfectly proper and entirely legitimate transaction, so long as one thing is directly equivalent to another in an invariable ratio. Here comes in the whole difficulty that will, we think, prove an interesting one in the future, and may land the station managers who adhere to the present system in difficulties.

It is a well-known fact that, while the electric motor is about as efficient as there is any hope of making it, the incandescent lamp is far from an economical translating device. Indeed, of all the energy put into the average lamp only a small percentage appears as light, the balance being converted into radiations of a wavelength unappreciable to the eye—in other words, into heat which is of no use to anybody. Every indication points to the great possibility of development inherent in the incandescent lamp. There is a possibility of making it anywhere from ten to twenty times as good as it is now. That this will be done no one who has observed the progress of industrial science during the last few years can possibly doubt. If it is done, the central stations will find themselves in a peculiar dilemma so long as they continue to sell electrical energy for illuminating purposes and not light.

The average sixteen-candle-power lamp consumes, while burning, about fifty watts of energy. Suppose that a lamp could be made which would deliver the same amount of light under a consumption of twenty-five watts. This we believe, in the light of present knowledge, is absolutely possible, and is certain, sooner or later, to be achieved. Under the circumstances a person at present satisfied with the light obtained from a certain number of lamps burning in his premises would receive precisely the same result in light from a consumption of one-half the current he now requires, which means that he would be equally well lighted and just as well satisfied while paying only one-half as much to the central station. It is true that this demand upon the central station would be only one-half what it is now, but if there is any profit in selling electricity, naturally the more that can be sold the more profit there is. Hence the introduction of twenty-five-watt lamps, which would cut the output of our stations in half, would also decrease their profits more than proportionately, because the fixed charges for interest on the plant would remain the same. They would then be driven to the interesting dilemma of lowering their rates for current, and hence for light, in order to secure more customers and thus absorb their output, or going out of business altogether.

If all customers used motors only, or if all lamps were equally efficient, and if there were no possibility of making them any better, doubtless the most satisfactory system of charging that could be devised would be a modification of the Wright maximum-demand method, which has been in successful and satisfactory operation now for a number of years. But is the gain to be made by the general introduction of systems of charging similar to this, or based in any way upon the current consumption of the customer, equivalent to the danger that underlies a system of charging based upon a single factor in the transaction between seller and purchaser, and a factor liable to be varied against the interest of the seller at any time? This is a plain question and one that should be discussed fully by such bodies as the National Electric Light Association and the associations of electric light station managers which meet in our various states. While there is no invention now on the market that seems likely to reduce the current consumption per candle-power of electric lights in an economical and satisfactory way, nobody aware of the facts can deny that such an invention is likely to be made at any moment, and that the great field for its introduction and extension not only invites the attention of those competent to design such apparatus, but would also make their widespread introduction certain within a short space of time after their appearance. Under the present system the appearance of high-efficiency lamps would prove a direct detriment to the electric lighting industry as it is usually conducted. Would it not be better, and in the end more satisfactory in all respects, to charge consumers by light-hour units of some kind, thus saving to the electric lighting station all possibility of increased gain through betterment of materials or gain through the opportunity for reducing prices and extending service that will come when such betterments have become commercial and practical?

The state of Colorado is at present undergoing the throes of a legislative debate concerning the reintroduction of capital punishment. For some years in that commonwealth the experiment of abolishing this variety of punishment has been attempted with indifferent results. A feature of the new bills before the legislature is the adoption of electrical execution patterned after the infamous example of New York state. Doubtless the legislators of Colorado are not fully aware of the facts in connection with this method of ridding the world of criminals, or they would hesitate. It is sincerely to be hoped that the opponents of the electrical method may win in the contest now going on, even if it is necessary to continue punishing condemned criminals by other than capital methods. Colorado can better afford to hang its condemned criminals than to institute the outrageous system of tortures still unhappily in vogue in New York.

The very interesting system of spark-telegraphy, developed by Professor Slaby, of Berlin, and recently described by him before one of the German scientific societies, is fully mentioned on other pages of this issue. Professor Slaby's system has created considerable interest and comment, not only abroad but in this country, and our readers will doubtless be interested in this exposition of his invention.

THE THEORY OF ALTERNATING DYNAMO ELECTRIC MECHANISMS—XIV.

BY W. ELWELL GOLDSBOROUGH.

If E_l is greater than E_c then the effective reactive electro-motive force E_x will be 90° in advance of the current, and, therefore, as shown on page 596 and in Fig. 36, the impressed electro-motive force will also be in advance of the current. In this case the circuit shows all the characteristics of a circuit containing resistance and inductance only, and the current lags behind the impressed electro-motive force.

If E_c is greater than E_l, there is a

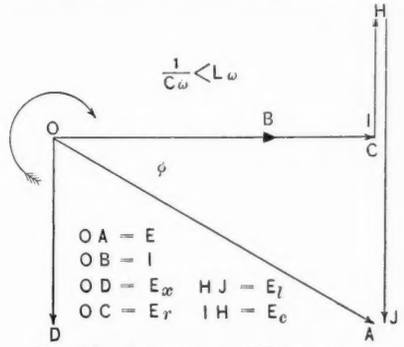


FIG. 36.—ALTERNATING MECHANISMS.

change in the relative phase positions of the impressed electro-motive force and the current. In this case the effective reactive electro-motive force E_x lags 90° behind the current, while the current is in advance of the impressed electro-motive force instead of lagging behind it. The reactions taking place in the circuit are entirely analogous to those occurring in circuits containing resistance and capacity only. The diagram of electro-motive forces for such a circuit is given on page 155, and in Fig. 37.

A third, and perhaps the most interesting case, is that in which $E_c = E_l$. In this case $E_x = 0$, and there are no reactive effective effects apparent. This condition is known as *resonance* in an electric circuit. The condition of resonance reduces the system, to all intents and purposes, to that of a simple, non-inductive circuit, as the current is in exact phase with the impressed electro-motive force and has a value as great as that given by Ohm's law.

In Figs. 36, 37 and 38 OB = I, the maximum value attained by the current; OC, which is in phase with I and equals

$$I\,r = E_r,$$

is the maximum value of that component of E (the maximum value of the impressed electro-motive force) which forces the current through the ohmic resistance of the circuit. The maximum value of the reactive electro-motive force E_x is shown as (OD) which is equal to (CA). (CA) is the resultant of (HI) = E_c and (HJ) = E_l. This resultant is shown to be at right angles to the current vector, as it should be, since the phase angle between them is always 90°.

The resultant of (OC) and (OD) is (OA) = E, the maximum value of the impressed electro-motive force, and as indicated in the figure

$$E = \sqrt{E_r^2 + E_x^2} = \sqrt{E_r^2 + (E_c - E_l)^2} \qquad (153)$$

The value of I can be expressed in terms of E and the dimensions of the circuit, for since $E_c = I \div C\,\omega$ and $E_l = I\,L\,\omega$, therefore (IH) = $I \div C\,\omega$ and (HJ) = $I\,L\,\omega$, and as stated above OC = $I\,r$, therefore,

$$E = I\sqrt{r^2 + \left(\frac{1}{C\,\omega} - L\,\omega\right)^2} \qquad (154)$$

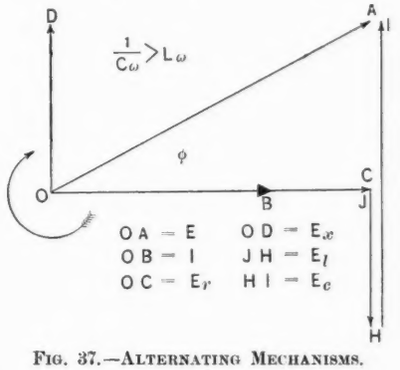


FIG. 37.—ALTERNATING MECHANISMS.

and

$$I = \frac{E}{\sqrt{r^2 + \left(\frac{1}{C\,\omega} - L\,\omega\right)^2}} \qquad (155)$$

The value of the angle of phase difference between the impressed electro-motive force and the current also depends directly upon the dimensions of the circuit. For since the tangent of the angle AOC = (CA) ÷ (OC), therefore

$$\phi = \tan^{-1}\frac{(C\,A)}{(O\,C)} = \tan^{-1}\frac{I\left(\frac{1}{C\,\omega} - L\,\omega\right)}{I\,r}$$

$$= \tan^{-1}\left(\frac{1}{C\,\omega\,r} - \frac{L\,\omega}{r}\right) \qquad (156)$$

Again, since the current flowing in the circuit is sine function, and since the angle of phase difference between the impressed electro-motive force and the current is the angle (ϕ), the value of the current at any instant is expressed by the equation

$$i = I \sin(\omega\,t + \phi), \qquad (157)$$

in which ϕ may be either a positive, negative or zero quantity, depending upon the relative value of the inductance, capacity and frequency of the circuit.

Combining equations (155), (156) and (157) we can finally obtain a more general expression for the current, since by the substitution of (155) and (156) in (157) we get,—

$$i = \frac{E}{\sqrt{r^2 + \left(\frac{1}{C\,\omega} - L\,\omega\right)^2}}$$

$$\sin\left[\omega\,t + \tan^{-1}\left(\frac{1}{C\,\omega\,r} - \frac{L\,\omega}{r}\right)\right] \qquad (158)$$

This is the form commonly given to the equation expressing the instantaneous value of the current. It can be derived by the direct integration of the fundamental equation of the electro-motive forces acting in a circuit containing resistance, inductance and capacity, which is usually expressed in the form,[1]

$$e = r\,i + L\frac{d\,i}{d\,t} + \int\frac{i\,d\,t}{C} \qquad (159)$$

in which e is the instantaneous value of the impressed electro-motive force, $r\,i$ the instantaneous value of an electro-motive force equal and opposite in value to the electro-motive force that overcomes the ohmic resistance,

$$L\frac{d\,i}{d\,t}$$

the instantaneous value of the counter electro-motive force of the induction coil and

$$\int\frac{i\,d\,t}{C}$$

the instantaneous value of the counter electro-motive force of the condenser.

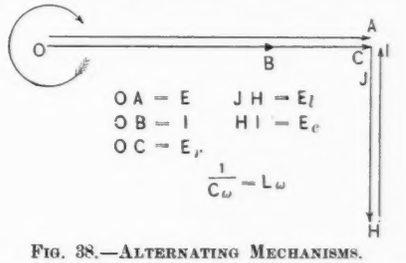


FIG. 38.—ALTERNATING MECHANISMS.

To obtain an expression for the instantaneous value of the charge in the condenser at any time (t), we have only to integrate equation (158), since $i = d\,q \div d\,t$, therefore

$$q = \frac{-E}{\omega\sqrt{r^2 + \left(\frac{1}{C\,\omega\,r} - \frac{L\,\omega}{r}\right)^2}}$$

$$\cos\left[\omega\,t + \tan^{-1}\left(\frac{1}{C\,\omega\,r} - \frac{L\,\omega}{r}\right)\right] \qquad (160)$$

$$= \frac{E}{\omega\sqrt{r^2 + \left(\frac{1}{C\,\omega\,r} - \frac{L\,\omega}{r}\right)^2}}$$

$$\sin\left[\omega\,t + \tan^{-1}\left(\frac{1}{C\,\omega\,r} - \frac{L\,\omega}{r}\right) - 90°\right] \qquad (161)$$

A thorough understanding of the in-

[1] For the direct integration of (159) see Bedell and Crehore's Alternating Current, chap. ix, page 127.

fluence exerted by each of the factors which enters into equation (158) is essential to a full knowledge of alternating-current working. In (158) are embodied in a great measure the principles which underlie the theoretical treatment of alternating-current power distribution systems, generators, motors, rotary converters and other adjuncts of central station equipment. It can not, therefore, be too carefully studied or too completely mastered. It is an expression which has a very wide practical, as well as theoretical, application.

When, as illustrated in Fig. 36, in a circuit of given frequency, the inductance of the circuit produces a greater reactance in the circuit than the reactance due to the capacity of the circuit, the effect is to produce a lagging current in the system. If the difference is made still greater by an increase in the capacity of the circuit the current will lag behind the impressed electro-motive force a greater and greater amount. When, finally, the capacity of the circuit becomes infinitely great equation (158), when applied to the circuit, reduces to the form,

$$i = \frac{E}{\sqrt{r^2 + L^2\omega^2}} \sin\left(\omega t - \tan^{-1}\frac{L\omega}{r}\right) \qquad (56)$$

since the value of

$$\frac{1}{C\omega}$$

approaches zero as a limit as (C) becomes greater and greater.

Equation (56) is the general equation of circuits containing resistance and inductance and has been treated on page 596.

If, on the other hand, as illustrated in Fig. 37, the capacity of a circuit of given frequency causes a greater reactance in the circuit than the reactance due to the inductance of the circuit, a current will flow that is in advance of the impressed electro-motive force. If the inductance in the circuit is gradually reduced the lead of the current will become greater and greater until when the inductance is reduced to zero, the conditions existing in the circuit will be expressed by the equation

$$i = \frac{E}{\sqrt{r^2 + \frac{1}{C^2\omega^2}}} \sin\left(\omega t + \tan^{-1}\frac{1}{C\omega r}\right) \qquad (147)$$

since, as the inductance of the circuit approaches zero, the value of $(L\omega)$ also approaches zero as a limit.

Equation (147) will be recognized as the general equation of circuits containing resistance and capacity in series. It has already been developed on page 155.

If a still further reduction should be made in the constants of the circuit, and its resistance, as well as its capacity, reduced to zero, equation (158) would have to be still further modified to express the conditions obtaining in the circuit. When, then, L and r both equal zero in (158) it becomes

$$i = \frac{E}{\frac{1}{C\omega}} \sin(\omega t + 90°) \qquad (136)$$

or, in other words, it reduces to another familiar form, and shows that if a harmonic electro-motive force is impressed on a circuit containing capacity alone a current flows in the circuit that is 90° in advance of the impressed electro-motive force.

Fig. 38 illustrates a third condition; one in which the reactance of an alternating circuit is reduced to zero, not because reactance is absent from the circuit but because the reactance of inductance exactly neutralizes the reactance of capacity.

If we apply this test to equation (158) by putting

$$\frac{1}{C\omega} = L\omega,$$

it reduces to the form

$$i = \frac{E}{r} \sin t\omega, \qquad (57)$$

which is the equation of the reactions which occur in a simple non-inductive circuit.

Equation (158) also reduces to the form of (57) when $(C = \infty)$ and $(L = 0)$, that is when capacity and inductance are in effect eliminated entirely from the circuit.

The latter case represents a very simple condition, the former, in which

$$\frac{1}{C\omega} = L\omega$$

and $C < \infty$ and $L > 0$, may represent a complex as well as a very undesirable condition.

When the reactance of the condenser neutralizes the reactance of inductance, the current although in phase with the impressed electro-motive force has a difference of phase of 90° with the reactive electro-motive forces E_l and E_c. In such a case, as has been already explained, $E_l = E_c$, the current lags 90° behind E_l, and is 90° in advance of E_c. Moreover, from (52) and (143) the values of E_l and E_c, although equal, depend upon the value of the current, and if the current is large E_l and E_c may be *very* large, so large, in fact, that the electro-motive forces induced in the inductance coil and the condenser may break down the insulation of the apparatus since they may be many times greater than the electro-motive force impressed upon the circuit.

This condition of neutral reactance or *resonance* in electric circuits can be brought about by a variation in the frequency of the circuit as well as by variations in either the capacity or the inductance of the circuit. For instance, if in a circuit containing resistance, inductance and capacity the frequency be varied the following effects will be noticeable. When the frequency is low there will be a leading current in the circuit, as it is gradually increased the current will gradually increase, but the angle of lead of the current in advance of the current will diminish. With a still further increase in the frequency the current will finally come into exact phase with the impressed electro-motive force. With this frequency, then, the current will have attained a maximum value, so long as r, L and C are kept constant, and any further increase in the frequency will cause the current to diminish in value, although for these higher frequencies the current will lag behind the impressed electro-motive force instead of advance before it.

The British Public and Electric Traction.

[*From the London Electrician.*]

"A wonderful invention, but don't bring it down our way!" Such was the attitude of our grandparents towards the steam railway; and such, it would seem, is the attitude of the public to-day towards underground electric railways. Stephenson and Brunel were belauded for their genius, but were urged to put their railways as far away from towns as possible; and, in more recent times, a meeting of Paddington householders decided that, while "no one who had enjoyed the quickness and cleanliness of these new underground electric railways would wish to oppose the multiplication of them, in order that the interests of residents in Paddington might be heard in Parliament, it was necessary that they should technically oppose" the bill for the construction of an underground electric railway in their neighborhood. Nor is this delicately expressed aversion merely formal, for a committee has been formed for the purpose of raising funds for active opposition. Meanwhile, we await the decision of the committee recently appointed by the Board of Trade to inquire into the alleged vibration troubles from this type of railway. Exaggerations there undoubtedly have been, in the statements in the newspapers, with regard to the extent of the disturbances; but it is important that if any serious vibration does occur the conditions should be determined, in order that a suitable remedy—for a remedy is undoubtedly available—may be applied. Nothing is more foolish than the popular supposition that the vibration troubles alleged to occur along the route of the "Tube" are *inherent* in either electric traction or the Greathead system of tunnel construction.

Professor Slaby's Tuned and Multiple Spark-Telegraphy.*

Professor A. Slaby, on beginning his lecture, explained that he entered upon his researches in "spark-telegraphy" with the idea of devising a system to replace that of Marconi, the prohibitive prices charged by the Marconi company rendering their system impossible of wide adop-

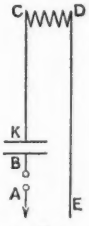


FIG. 1.—MULTIPLE SPARK TELEGRAPHY.

tion by any but the English navy. Prompted, then, by a desire to assist the employment of spark-telegraphy in the German navy, the author, assisted by Count Arco, commenced a series of experiments which they little guessed would lead them to something better than the mere similarity to Marconi's performance which they aimed at. And last Summer he hit upon their present method of exact tuning, Count Arco being mainly responsible for the working out of the practical details.

Professor Slaby then entered at length into the elementary theory of the electric oscillations on an air-wire, and showed that a potential node exists at the earthed end, and at the free upper end a potential loop, and hence that the wave-length of the oscillations is four times the length of the air-wire. Hitherto the practice has been to lead the insulated air-wire to one terminal of the coherer, whose other terminal was earthed. The large capacity of the coherer, however, makes its air-wire end a potential node, and thus but poor results were obtained. The fact

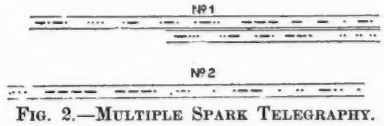
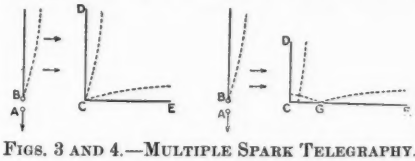


FIG. 2.—MULTIPLE SPARK TELEGRAPHY.

that signals were obtained with this arrangement is accounted for by the existence of other frequencies among the incident waves. But pursue instead the following plan: Lead the air-wire directly to earth, so as to produce a true node of potential, and connect there another wire of length equal to the air-wire, and with a free end. At the free end of this extension is produced a potential loop similar to that at the free upper end of the air-wire. This extension need not be stretched away in a horizontal line; it may be wound on a reel. It is found to increase greatly the accuracy of signaling, and is, in fact, the kernel of the Slaby invention. In the lecture demonstration the extension wire of calculated length was led directly from the lightning conductor to the receiving apparatus in the room.

Till some such method as the above was found, tuned telegraphy was impossible. According to Professor Fleming, Marconi has found such a method, but he keeps his solution of the problem secret. In practice the Slaby-Arco solution consists in two corresponding stations working with consistent wave-lengths, whose diversity is controllable within wide limits. The manner in which a certain wave-length only is detected is set out above; the method of producing a definite wave-length follows. The apparatus is a modification of that which was first described more than a year ago, and has since been in use in the German navy. It is designed to produce as much oscillatory energy as possible. Instead of the single insulated wire an earthed loop of wire



FIGS. 3 AND 4.—MULTIPLE SPARK TELEGRAPHY.

is used (Fig. 1), to which is attached one plate of a condenser of Leyden jar form. In the charging of the system the whole loop, closed through the earth, as shown, is used; in the discharging the part KC only is employed. The discharge commences when the spark begins, and is powerfully oscillatory. The coil of wire CD prevents the passage of the oscillations to earth by DE. This apparatus produces waves of a definite length calculable from the known capacity of the condenser and the known length of the wires.

Messages were then received simultaneously from a station at Schönweide, eight miles distant, and from the lecturer's laboratory at Charlottenburg Technical College, about two and one-half miles distant. The rate of transmission was about 72 letters per minute. Fig. 2 is a reproduction of two simultaneously received messages.

The author, since the delivery of his lecture, in replying to questions concerning the path by which he was led to his discovery, states that he was guided solely by purely theoretical considerations. The theory of the air-wire leads to the differential equation.

$$R_1 \frac{d\,i}{d\,t} + L_1 \frac{d^2\,i}{d\,t^2} = \frac{1}{C_1} \cdot \frac{d^2\,i}{d\,x^2},$$

where i is the current at any time t at the place x on the air-wire, and R_1, L_1 and C_1 are the resistance, self-induction and capacity per unit length of the wire. A solution is

$$i = A\, e^{\frac{R}{2L}t} \cos \frac{2\pi}{T} t \;.\; \sin \frac{\pi}{2l} x,$$

where

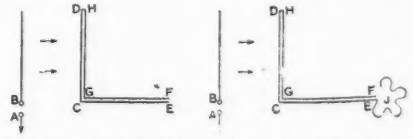
$$T = 4\sqrt{L\,C},$$

l is the length of the wire, A is a constant, and R, L and C relate to the whole length of wire. The frequency is $\frac{1}{T}$, and the wave-length is equal to $4\,l$. The potential fall per unit length of wire is

$$\frac{d\,v}{d\,x} = B\, e^{\frac{R}{2L}t} \cos \frac{2\pi}{T} t \;.\; \cos \frac{\pi}{2l} x.$$

These formulæ show that the oscillations follow the simple harmonic law, and that the free end of the wire is a potential loop and the lower end a potential node. The simple relation between wave-length and wire-length is considerably affected, however, by the proximity of the earth, and an increase in the slope of the wire makes a great alteration in its capacity and hence in the wave-length. These alterations can be followed only by experiment, but both Professor Slaby and Count Arco have shown that the above simple relation may, roughly, be adhered to.

Consider then, a straight vertical wire, B, acting upon a distant vertical wire, CD, as represented diagrammatically in Fig. 3. During an oscillation nodes occur on both wires at the earthed parts A and C respectively. Suppose, now, a second wire, CE, beyond the inductive action of B, attached at C. At E, then, is produced a potential loop of strength equal



FIGS. 5 AND 6.—MULTIPLE SPARK TELEGRAPHY.

to that at D. The earth connection at C has no effect in this case. If the receiver wire be shorter than the inducing quarter wave-length (Fig. 4), then at D and E loops are again formed as before, but an earth connection at C greatly weakens these. An earth connection at G, however, has no effect. If the air-wire is a loop, as shown in Fig. 5, D and H being connected, then at D, H, E and F equal potential loops occur, and at C and G nodes. But if to E a length of wire J be attached (Fig. 5), and if this wire EJ be a half wave-

*Lecture delivered before the German Emperor, at Berlin, December 22. Reprinted from the *Electrician* (London).

length, then a phase difference of 180 degrees is established between F and J, and, as experiment confirms, the potential difference between E and J is double that between F and earth. Moreover, the whole receiving apparatus may now be earth-free—a great advantage; and the effects due to atmospheric electricity are completely eliminated. By a happy inspiration Count Arco abolished one of the two wires in the last-described apparatus and thus this is reduced to a single wire DCE and J, the coherer being applied between J and E.

The theory of the intensifier described above is not quite simple. In the author's opinion, its action depends on a shifting of phase in the windings of the coil, with an inversion in direction of the mutual induction in some of them.

In concluding, Professor Slaby mentions that the Secretary of State for the German navy has consented to a number of experiments being made on warships in order that the maximum distance attainable by this means of signaling might be determined.

Science Brevities

Nickel Manganese Steel—From the experiments of Hadfield, Barrett and Brown it would seem that the steel containing:

Ni	25.00
Mn	5.04
C	0.60

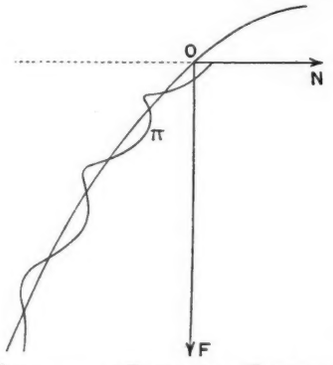
has the highest resistivity of any commercial metallic conductor yet produced, being equal to 97.52 microhms per cubic centimetre at 15 degrees centigrade. This, says a British contemporary, gives the alloy a resistivity 60 times greater than that of pure copper, 10 times that of iron and 4.5 times that of German silver.

Silicides—The formation of the silicides of the alkaline earths Ca Si_2, Ba Si_2, Sr Si_2, by heating the earths with silica and carbon in the electric furnace, gives us a new series of compounds analogous to the carbides, and it is hoped that they may be of commercial importance as a convenient source of pure hydrogen, thus:

$$Ca\,Si_2 + 5H_2O = 2SiO_2 + CaO + 5H_2.$$

It will be seen that the yield of hydrogen gas is large, as a kilogramme of the calcium silicide will yield about 1,000 litres of pure hydrogen. If the water is acidulated, the silicon-acetylene $Si_2\,H_2$ is produced; it, however, is a yellow crystalline compound, and does not, therefore, bear much resemblance to its carbon analogue.

Motion of an Electrified Particle—Herr E. Riecke has investigated the case where an electrified particle or ion moves in a magnetic field upon which an electric field is superimposed, both fields being uniform. The result of analysis shows that the particle moves along a cycloidal curve, according to one of Mr. Fournier d'Albe's abstracts. In the diagram, OF is the direction of the electric force and ON is normal to OF and to the magnetic force. The projection of the path of the particle upon the plane FON is the curve π. The axis of the cycloid is a parabola, the generating curve is no circle but an ellipse, and the arcs of the cycloid expand during the motion. These results have an important



MOTION OF AN ELECTRIFIED PARTICLE.

bearing upon the phenomena in the vicinity of the cathode, the changes in luminous layers under magnetic influence, and the theory of the aurora.

Depilation by High-Tension Electric Currents—At a recent meeting of the Vienna Society of Physicians, Dr. Schiff and Dr. Freund reported an interesting action of high-tension currents on the skin. According to the authors (says the *Lancet*), when the hairy skin is exposed for 20 minutes to the silent discharge of the negative pole of a powerful Ruhmkorff coil, such as is used for the production of the Rœntgen rays, the hairs commence to fall out, the hair-bulbs become atrophied after the third exposure, and some days later the portion of the skin which had been exposed becomes perfectly bald. The hair follicles become red and inflamed after the first two exposures. These observations seem to prove that depilation can be produced by the action of high-tension currents, and that the depilatory effect of exposure to the Rœntgen rays may be accounted for in this way.

Coherers—Rœntgen rays often exert an apparent influence upon the resistance of coherers, says an *Electrician* abstract. Thus Herr C. Jensen mentions that when he introduced a Rœntgen tube into the secondary circuit of an induction coil a Kohl detector for wireless telegraphy showed an immediate response. The response occurred even after taking all kinds of precautions against stray sparks, but it was entirely obviated by enclosing the Rœntgen-ray tube in a box with an aluminum window, through which X-rays could freely penetrate. It is therefore clear that X-rays alone do not produce the effect described. The real cause of the effect upon the coherer was, after much investigation, found to lie in the appearance of "gliding sparks" inside the Rœntgen tubes themselves. These gliding sparks play about the metallic conductors within the tubes, and appear to glide to and fro along them. That these sparks are the true cause of the phenomenon is made probable by the fact that the appearance or non-appearance of the response depends upon the position of the point at which the sparks appear with respect to the coherer. Preliminary experiments with Becquerel rays show that they have no influence upon coherers.

Electrolytic Iodoform—The success which has attended the electrolytic manufacture of iodoform under Schering's German patent has stimulated investigators to attempt the manufacture of chloroform in a similar manner. Douy-Hénault, however, shows that on theoretical grounds neither bromoform nor chloroform can be economically produced in this way, says *Lightning*. Iodoform is formed by the action of unstable hypoiodous acid upon the alkaline alcoholic solution, thus:

$$C_2H_5OH + 5HI = CO_2 + CHI_3 + 2HI + 4H_2O$$

and not by the action of free iodine, the yield being 20 to 40 per cent more by the electrolytic process than in the older method of manufacture. This depends upon the relative velocity of the two different ways in which the hypoiodous acid may decompose. These are (1) the production of iodate

$$HIO \rightarrow HI, HIO_3$$

and (2) the production of iodoform

$$HIO + C_2H_5OH, \rightarrow HI, CHI_3$$

By the addition of iodide or iodate the first of these alternate processes is retarded so that the second proceeds, causing the increased yield in the iodoform. In the older process of manufacture the iodide and iodate are destroyed after each operation, but it would seem from the above reasoning that, if iodide and iodate were added to the solution first, the amount of iodoform produced by the chemical method might be increased. As iodine is soluble in a solution of potassium iodide containing iodate, it might be desirable to experiment in this direction.

The History and Development of the Electric Fan Motor.

By F. V. Henshaw.

Among the commercial applications of electric power perhaps the most peculiarly American one is the fan motor, the great and rapid development of which must be due to the climate and love of luxury characteristic of the country. Any one who has enjoyed the breeze from one of these little fan motors on a hot Summer's day and contrasted the subsequent discomfort when it was turned off will realize the commercial value of the device. It appeals directly and strongly to personal comfort and therein is the secret of its success.

Who was the first to feel and realize this it would be difficult to say, but it may be stated that the fan motor originated about 14 years ago at most.

Among the very first applications of electric motors was driving ventilating fans by belting, but the first fan motor proper, that is, a motor having a small fan mounted directly on its shaft and self-contained, was probably that of Bergmann who, in 1887, was making a small motor having an inverted U-magnet and Siemens armature. This motor he mounted on a four-legged table and on its shaft placed a four-blade brass fan. The arrangement was obviously an awkward one and very few were made.

In 1886 the C. & C. Electric Motor Company brought out the small Crocker and Curtis battery motor and battery which was the first small motor of practical commercial value put on the market, and in the following year, Dr. S. S. Wheeler, then manager of that company, conceived the idea of a practical fan outfit and in carrying out this idea inaugurated what has since become a large industry.

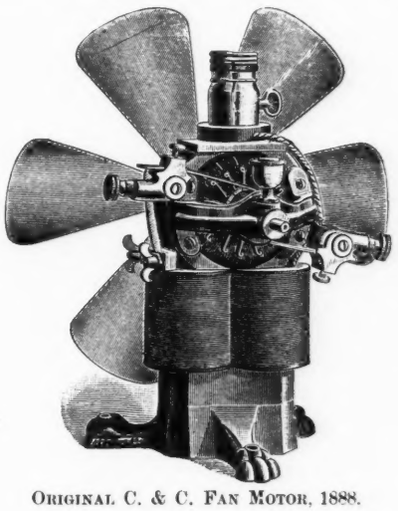
The original C. & C. motor consisted of an inverted U-field magnet and ring armature, the latter about three and one-quarter inches in diameter by two and one-half inches long, the motor being about nine inches high.

The field magnet was reversed and mounted on a casting having three feet, which acted both as a magnet yoke and support. By this means the shaft was brought high enough to admit of mounting on it a 12-inch six-blade fan, the whole making a neat and compact device.

These motors were first wound for primary battery supply of four to eight volts and 20 amperes capacity, the armatures being wound in a very ingenious way with flat wire wound by machine on edge and afterwards slipped over a split ring core.

With the eight-volt four-cell battery furnished with them they would run about 1,000 to 1,200 revolutions per minute for some eight hours.

A number of these battery fan outfits were used in sick rooms, etc., and it was thought at one time that there would be a great field for them in India to replace the punkahs, but primary battery maintenance and first cost could not compete



Original C. & C. Fan Motor, 1888.

with the patient oriental at some five cents per day.

In considering the birth of the fan motor, or "fan outfit," as it came to be called, the discussion on a paper by Dr. S. S. Wheeler before the American Institute of Electrical Engineers on February 6, 1887, is interesting.

On this occasion in reply to a comment to the effect that, in the case of driving fans, motors of one-half horse-power or more would be required, Mr. Wing, the well-known authority on ventilating fans, said: "No, sir; a thousand could be sold for that purpose at about one-eighth to one-quarter horse-power for sleeping rooms."

In 1877 and 1888 the chief source of electric supply was from arc lighting stations, there being but a few towns having a limited area reached by low-tension incandescent lighting mains.

People did not have the same respect for a constant-current arc circuit that they do now and these circuits were run everywhere inside and outside of buildings, so these years saw the rapid rise of the constant-current motor into general use. It is not easy to find one to-day, but down to about 1892 they were built by thousands.

In 1889 the C. & C. Electric Motor Company was making three standard fan motors using one-eighth, one-quarter and one-half horse-power motor frames, having 12, 18 and 24-inch fans respectively, and winding them for six and one-half and nine and one-half ampere constant-current, 110-volt constant-potential and primary battery currents. The vast bulk of these were the one-eighth horse-power 12-inch fan combination, which came to be the standard fan outfit.

The 110-volt motor was series wound, having a 15-section armature wound with No. 27 wire, the field being wound with No. 23 and on top, attached to a brass block bolted across the poles, was an incandescent lamp socket. A switch was provided in some cases for connecting the lamp in series with the motor, but the usual method was to connect the socket permanently in series with armature and field and insert either a lamp or short-circuit plug for low or high speed respectively.

With the lamp socket short-circuited these motors would run the regular six-blade 12-inch fan, 1,400 to 1,500 revolutions per minute with .9 to 1 ampere on a 110-volt circuit. The fan blades had a pitch of about 30 degrees and were shaped like a section through the axis of a cone with corners rounded.

For "arc circuits" most of the motors were shunt wound, the speed being controlled by the Wheeler regulator. The field was wound in six sections and a switch provided that would cut in these sections in five steps. The switch lever had long projecting arms to which cords could be attached. A test of one of these one-eighth horse-power arc fan motors in the various switch positions gave:

Amperes.....	9.2	9.2	9.2	9.2	9.2
Volts	8	12	16	18	20
Revolutions	...900	1,260	1,700	2,000	2,200

At the latter speed the blast of air was terrific.

A later arc fan motor was devised by the late Harvey Lufkin and L. W. Serrell, and had two series field coils, differentially wound with an additional German-silver

resistance winding which was switched in sections into the reverse field coil, thus regulating speed. The resistance winding proved objectionable and the Wheeler regulator continued in use until the Edison three-wire and the alternating-current systems drove the constant-current supply for motors out of business.

In 1889 the Crocker-Wheeler Electric Motor Company took up the manufacture of fan motors and rapidly built up an extensive business, supplying them largely to the Edison General Electric Company and the Sprague Electric and Railway Company, these large concerns not having taken up the construction of small motors at all. The Crocker-Wheeler fan motor was much like the C. & C. in general, but had a toothed armature and stood on four feet instead of the classic three paws of what may be called the original fan motor.

The regulation of the "arc" motor was effected by the simple means of shifting the armature a sufficient distance out of the fields to secure the desired speed and holding it by setting the hub of the fan against the bearing. A plain series winding was used and, of course, considerable end play of armature had to be allowed and a long commutator provided to permit speed changes. As the fan motor came into general use various improvements and novelties were brought out.

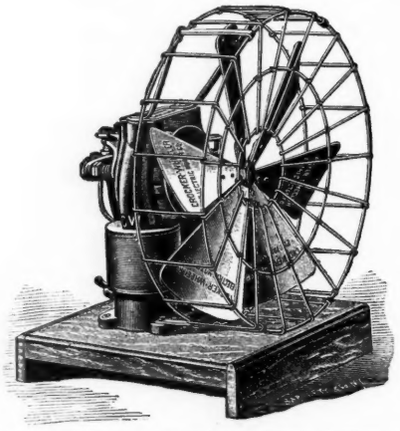
The C.-W. "Blow Anywhere" fan had the motor mounted in a ball joint on a wall bracket so that the motor could be set to blow in any direction.

The same makers produced a fan motor mounted in a bearing so that the blast from the fan caused the whole machine to rotate slowly, sending a swirl of air sweeping around in a startling manner. One of the early improvements, probably due to the Crocker-Wheeler company, though used by all makers, was the fan-guard, consisting of a brass wire cage around the fan. This device was, of course, to protect anything such as a head or hand from mutilation, but, as a matter of fact, it seems to owe its origin to a desire to prevent the fan or parts of it from coming out.

Before the fan-guard was used several accidents occurred through blades coming off. On one occasion a plate-glass mirror was wrecked in Chicago, and on another a peaceful citizen, eating his lunch, had a neat groove cut in his scalp. These accidents were rare, considering the number of fans in use and the way they were set up, but the fan-guard put an end to them entirely. No record exists in regard to damaged fingers.

The ceiling fan deserves some mention and the credit for this seems to belong to Mr. Philip Diehl, though such fan motors were also made at an early date by Dennison and the Crocker-Wheeler Electric Company. These motors all had large diameter ring armatures driving a two-blade wooden fan and are common enough to-day.

The height of the competition in fan motors was reached in 1891, the enormous extension of electric supply from central stations having given the business a great impetus. New makes appeared by the dozens, the designs being chiefly variations in the type of motor and generally inferior to the established forms until the introduction of the enclosed motor which,



Crocker-Wheeler Fan Motor with Original Fan-Guard, 1890.

from its compactness and the protection to its moving parts, at once became popular. The Lundell motor may be considered as making a new departure in fan motors.

Its construction of spherical field with single field coil and toothed-drum armature is too well known to require description. The spherical form made it particularly neat, when mounted on a pedestal for the purpose of a fan motor. Until the Spring of 1891 there had been a demand for a small fan motor to run on 500-volt mains which remained unsatisfied, because none of the fan motors could be wound for this pressure. To meet this demand, the writer designed a special form of motor which is of some interest owing to the difficulty involved in making a very small commercial motor for this relatively high pressure.

The economic requisites in the design of large machines are, to some extent, reversed as, owing to the great cost of very small wire, it was necessary to design the motor for a maximum rather than a minimum weight of copper. Also the motor had to be of such shape and size as not to block the fan draught in addition to meeting consideration of cost and portability. To meet the case a motor was designed having a cylindrical shaped field made up of two castings embracing a single field coil and held at the back ends by a bolt, the front ends projecting to form the poles. The lower casting has a hollow round core over which the field coil is placed and through the centre of which the shaft passes.

With this construction it was possible to obtain the maximum diameter of armature and maximum field wire space with moderate dimensions and without blocking the admission of air to the important part of the fan blades. This form of motor was later made in sizes up to five horsepower capacity at 300 revolutions for direct-connection to 60-inch ventilating fans.

In the great increase of the fan motor business in 1890 and 1891, the larger electrical manufacturing companies began to realize that they had neglected a profitable field.

In a published description of the Perret fan motor, in the Summer of 1890, it was remarked that "some of the electric motor companies have considered the fan business as beneath their dignity," in spite of which, in the following Spring, the Stanley Electric Manufacturing Company, the Edison General Electric Company and the Westinghouse Electric and Manufacturing Company all brought out and put on the market small fan motors.

The Stanley fan motor was designed for alternating current and, in common with practically all such motors before and since, had a circular laminated field. Its armature was similar to that of a direct-current motor, having a commutator, and it was, in fact, a simple series motor driving a six and one-half-inch diameter, four-blade fan. The current required was about one and one-half amperes at 50 volts.

The Edison fan motor was of most extraordinary design, consisting of a single field coil and core uniting two castings shaped like tuning forks. On the inside of each prong of the forks was screwed a laminated pole-shoe and between these rotated a ring armature having radial slots for windings. The merit of this construction has not yet been made clear.

The Westinghouse company brought out a series wound, laminated field motor, mounted on a column and base, driving the usual six-blade fan. This motor was intended for either direct or alternating current.

As the use of constant-amperage arc current for motive power supply decreased its place was taken by single-phase alternating current and the alternating-current fan motor grew into existence.

The Meston alternating fan motor, a description of which was first published in May, 1891, probably deserves the first place. This motor was and is manufactured by the Emerson Electric Manufacturing Company, which has found it very successful. Alternating single-phase motors had been made with a simple iron rotor at first and caused much annoyance from the fact that they would, in the most erratic manner, run in either direction, as suited their fancy, and often would not run at all.

The Wagner motor came out about the same time and scored a success at once.

All these single-phase motors have practically the same laminated cylindrical stator or field, which is a form mechanically well adapted for a fan motor.

Iron rotating inductors started by switching in displaced field coils in starting. Professor Thomson's periodically short-circuited armature coils, or plain series connection with ordinary direct-current form of armature, have been used.

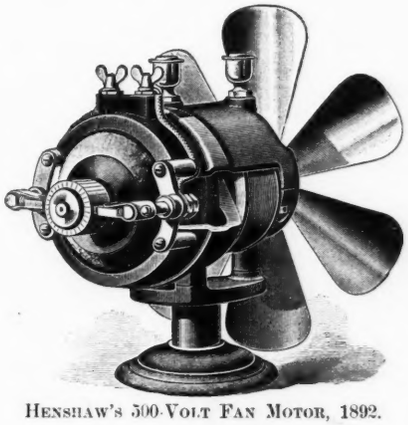
The most popular device for alternating-current fan motors at first was the series motor with laminated field, probably because the makers were pretty certain as to what it would do and were not getting very far away from familiar practice. So far we have considered what is known generally as the "fan motor" or "fan outfit," which term may be considered as meaning a motor of nominal one-sixth horse-power or less, having a fan mounted on its shaft and generally used to circulate air but not to ventilate.

The use of the expression in this sense is so general that when a very small power is required for any purpose it is common to hear such a remark as "an ordinary fan motor will do."

In concluding this sketch of the fan motor, it is appropriate to consider the future possibilities of this branch of electrical manufacture.

In 1888 there was practically but one fan motor on the market. Ten years later there were at least 20, while this season will see the electrical journals crowded with advertisements of them. It is difficult to make any estimate of the number built, but during the past five years there must have been some 50,000 at least turned out, which would represent, say, $1,000,000 value. The fan motor has followed exactly the development of electric power and lighting, and, with the extension of these, its use will constantly grow. The future demand for these cooling machines in the far east should be enormous and, in fact, there are few products of America that will have a better opportunity at the "open door."

One instance may be mentioned, *viz.*,

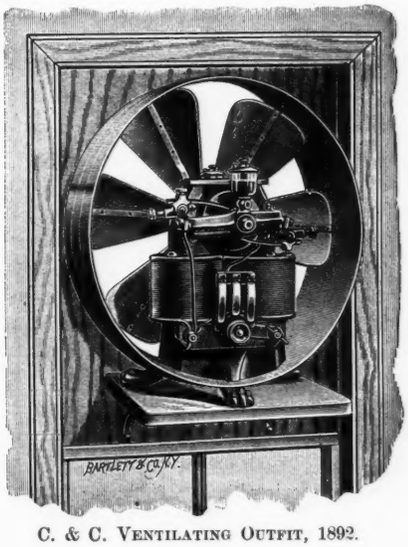


HENSHAW'S 500-VOLT FAN MOTOR, 1892.

the city of Calcutta having nearly a million population in an intensely hot climate and in which an electricity supply station was erected in 1899.

Professor Crocker on his return from a trip to the far east pointed out strongly the commercial conditions above mentioned.

One might hazard a guess that, if railway building in China does not advance



C. & C. VENTILATING OUTFIT, 1892.

more rapidly, the Chinese railroads when they do come may be electric and not steam, and if so, the electric lamp and fan will be there also.

The motor-driven ventilating fan may be considered as quite distinct from the "fan motors" described above, not only being larger but also having a different purpose involving more complex requirements. Such fans are of two distinct classes, *viz.*, the disk of propeller blade fan and the centrifugal fan.

Probably one of the very first uses of the stationary belted motor was the driving of ventilating fans. Early in 1890 direct-connected machines were brought out having the motor supported by arms bolted to the fan frame. Among the first, if not actually the first, of these was the old Daft motor, with its four field coils of Siemens type with two consequent poles, connected to a Blackman fan.

Owing chiefly to a lack of appreciation of the action of disk fans and of the radical difference between their action and that of centrifugal fans the pioneers in this line had continual trouble due to overloaded motors.

As even at the present day there are mistakes of this kind made, it may be well to point out the essential facts pertaining to the work in question.

Disk fans move large quantities of air at low pressure. They are reversible and so can be used to move air in either direction parallel to the shaft, also they can be run as motors by wind pressure. The power to drive them increases considerably when the discharge is blocked or restricted and increases enormously with increase of speed. Owing to the latter property they are convenient for small dynamometers for artificial load which can be increased to anything within the strength of the fan to hold together by relatively moderate increase of speed.

Centrifugal fans and blowers move small quantities of air at relatively high pressures. They are not reversible and will blow air in the same direction irrespective of the direction of rotation.

The power to drive them decreases when the discharge is blocked and increases in a much less ratio than with disk fans when speed is raised. The following test records will illustrate the difference in the power required by the two kinds of fans under working conditions, it being remembered that closing more or less the discharge opening is equivalent to connecting the fan to a system of pipes or ducts which choke the discharge in proportion to their length and area.

Test of a 60-inch disk fan with direct-connected series motor showing input of motor under various conditions of discharge:

Discharge opening.	Amp.	Volts.	Revolutions.
Free—60-in. diam.	24	112	360
Reduced to 3 in. x 3 in.	31	111	335
Closed completely.	41.5	110	305

Test of a centrifugal blower with direct-connected series motor giving same data as above. External diameter of blower

about 44 inches, diameter of discharge 16 inches. Motor wound for 80 volts to be used on shipboard:

Discharge opening.	Amp.	Volts.	Revolutions.
16 in. diam.	40	75	800
11 " "	38	75	875
Closed completely	30	78	1,100

The first of the above tests shows why there was trouble with disk fan motors in the early days. A shop test would show the motor driving fan at proper speed with normal power required. The fan would then be set up perhaps to force air through a relatively small duct from the basement to roof of a skyscraper and the load on motor would go up 50 per cent or so. If the motor was in a hot engine room—and, in the nature of the device, the motor is always in the hot air, being drawn out wherever it is placed—it would not be long before it was heard from.

A case of this kind occurred in a Broadway building, where the terrific overload on a ventilating fan motor resulted in an investigation and it was found that the vertical air duct was almost completely blocked some distance from the top by a careless builder.

Regulation of speed of disk fans is very commonly obtained by multiple field coils which are cut in series by a switch. This makes a very neat outfit, but it may be pointed out that as the power required by these fans falls rapidly with the speed, regulation by resistance in series with motor is more economical than with any other class of machinery. The argument against such method of speed regulation on the score of inefficiency is not of such weight as regards disk fan motors as it is in most other cases.

To illustrate this the measured input, reduced to horse-power, of a 48-inch disk fan with direct-connected motor, is given below. The readings were taken with fan having free circulation and speed was regulated by means of multiple series field coils. The efficiency of motor was approximately from 65 per cent to 80 per cent over the speed range.

Revolutions.	300	350	400	450	540
Horse-power.	1.55	1.9	2.35	3	4.35

Of the general use of direct-driven ventilating fans it is not necessary to speak. Any modern large city building furnishes examples enough of such machinery.

Centrifugal blowers are used almost exclusively on shipboard, particularly in the navy, though some of the latest warships have also disk fans. The great steel-plate fans of the Astoria Hotel are an example of the development in extremely large sizes of the direct-driven blower.

The Baltimore was one of the first vessels of the United States navy to use such blowers, and shortly after a number of them were shipped from America for use on ships of the Italian navy.

In conclusion it may be said that the production of successful and satisfactory direct-connected, motor-driven fans and blowers has not come without the efforts of many brains, and hands too numerous to mention, even were it possible to name them all. In this respect the history of this industrial branch of engineering is the same as that of more complex and greater works.

Electric Fans for 1901.

Various Prominent Styles of Direct and Alternating-Current Fan Motors Described and Illustrated.

While the casual observer might conclude that the electric fan is a small feature of the industry of applied electricity, still the extraordinary growth and remarkable development of the business of making and selling these machines during the last few years has made the electric fan one of the most notable applications of electricity to comfort.

Perhaps in no way has electricity so directly influenced the well-being and satisfaction of the public at large as in this peculiar application. Notwithstanding the enormous advantages of the electric light, we had before its introduction other lights which gave a reasonable degree of satisfaction; and notwithstanding the vital value of electric traction as a means of transit, we had before its beginnings the steam locomotive and the horse. But before the day of the electric fan we had nothing that compared with it, and we sweltered in the tropical atmosphere of American cities through our Summers with no amelioration and no kindly breezes produced by other than natural means. The introduction of the electric fan has saved many a trip to Coney Island or kindred resorts and has vastly reduced the sum total of profanity and perspiration in the summer-time. Whether or not the American is a more luxury-loving person than the citizens of other nationalities, he is certainly the one who has most particularly welcomed the electric fan and made it at home in his territory.

In succeeding pages are shown in some detail the types of electric fans offered by American manufacturers for the ensuing season of 1901. It is interesting to note that these types differ very little from those that were put on the market for the last Summer's trade. This fact, in view especially of the enormous consumption of such machines and a growing export trade in them, is sufficient to show that the electric fan has reached practically a perfected condition, and that little change will probably be made in it in the future. Indeed, any one who noted the perfection of operation of these devices last year and the year before might have suspected that little change would be made and that the new types would not differ materially from those that had been in vogue for some seasons. The efficiency of the desk fan has been improved until the machine requires no more current than the ordinary 16-candle-power lamp. One feature that has added very much to its widespread adoption is the facility with which the machines may be installed. They may be set down anywhere without requiring foundation or attachments and connected through convenient lengths of cord to any nearby lamp socket. Perhaps the greatest recent progress has been made in the development of fans operating on alternating currents, these machines having been brought to a high perfection and certain objectionable features that were noticed about the early types having been entirely eliminated.

There is a growing use of ceiling fans in places of business, restaurants, hotels, etc., and it is likely that this particular type of electric fan may soon find a more widespread adoption in residences of the better class. A recent improvement in the design of such machines has reduced their size and accomplished the same results that were reached by the older slow-moving, long-arm varieties with smaller blades running at a higher rate of revolution. In both types mechanical perfection has been carried to such a point that

the fan runs easily through the Summer season without the least attention, requiring neither oiling nor adjustment of any of its parts.

Electric fans have proven a useful and remunerative load for central stations, the period of their greatest use coinciding with that of the least use of electric light. In general the majority of fans attached to the circuits of a station are operated during the day time, thus forming a good day-load, while the Summer season with its short evenings and correspondingly small consumption of energy for lighting purposes is the time in which the fan is most in demand. For this reason central stations in the past have endeavored to encourage the use of fans and to-day, partly through their efforts but perhaps most largely through the appreciation of the public for a genuinely good thing, one finds that the electric fan is ubiquitous in all American cities of the better class. Perhaps if it were possible to totalize the comfort that has been brought through these small machines, or to form any adequate conception of the suffering and misery that they have ameliorated, we would be ready to proclaim that they are one of the most useful of the many appliances that electricity has given to civilization.

A WORD FROM THE PAST.

Even as much as seven years ago there was some discussion as to who invented the fan motor and when. In the ELECTRICAL REVIEW for July 18, 1894, there appeared a story as follows:

God certainly should bless the man who first conceived the electric fan.—ELECTRICAL REVIEW, *June 27, 1894.*

Dr. Schuyler S. Wheeler, of the Crocker-Wheeler Electric Company, of this city, noticed the above paragraph in the ELECTRICAL REVIEW, and being an aspirant, with the rest of us, for heavenly blessings, put on his thinking cap. After a little cogitation and reference to an old scrap-book, he believes he is the man who invented the electric fan and, consequently, is entitled to the especial blessing invoked by the ELECTRICAL REVIEW.

In Dr. Wheeler's scrap-book is pasted a little pink folder advertising the fact that the "C. & C." Electric Motor Company, Room 18, Tribune Building, New York city, was prepared to furnish an electric battery and outfit to operate sewing machines. On the first page of the folder was a picture, which is reproduced herewith. This pink folder, the "C. & C." company's first advertisement, was issued about April or May, 1886. The "C. & C." Electric Motor Company was about the first motor maker of consequence in this country, and Dr. Wheeler was its electrician and superintendent.

"One day," said Dr. Wheeler to an ELECTRICAL REVIEW representative, "I suggested turning the sewing machine form of motor upside down, so as to bring the shaft up higher and putting on a 'thing like a propeller.' Then I sketched out a piece to replace the yoke. This piece had three feet carved like an animal's paws, each paw having three toes. I remember that it was a very momentous question at that time whether there should be three or four toes. The Jackson Architectural Iron Works made up these iron pieces for us. The combination attracted considerable attention and we immediately began making the fan outfits as a regular article. Then the other companies took up the idea. We used a 12-inch, six-blade fan, and an Edison incandescent lamp on top of the motor for resistance. I estimate the number of electric fans made since then at 25,000."

In this connection it will be interesting to note how the "C. & C." motor came into existence. It was invented through the fact of Mr. Roberts, of the Roberts-Brevoort Battery Company, coming to Messrs. Curtis and Crocker, as experts, and saying it was a pity there was not a correctly designed small motor in existence; that he had just perfected a very good power battery with which he could run sewing machines and do other work if he only had a motor with any degree of efficiency whereby he could convert a large enough percentage of his battery power so that he would equal the work of the sewing machine. They replied that there was no difficulty in getting up such a motor and that it was remarkable that it had not been done before, and that they would undertake it. They got up such a motor, and when it was tried the result was not satisfactory. This surprised them very much, as they were confident of the correctness of their calculations, and, upon close investigation, they found that the battery did not give a current and maintain its electro-motive force as claimed, but that the motor, when supplied with the expected current, would give the required power. They then found themselves in possession of a good motor, but without a battery to drive it, and, consequently, to make an operative outfit were obliged to undertake the design of a battery. This was successfully accomplished, producing the "C. & C." plunge battery, which, together with the motor, made a very successful sewing machine outfit. About this time Dr. Wheeler left the Herzog Teleseme Company and joined Curtis & Crocker in this business. After getting up the first 150 machines, which were for the late Joseph B. Stearns, of Boston, of telephone fame, one of the first things Dr. Wheeler did was to invent the electric fan motor as told above.

It is rather a curious fact that the same mistake as made by Edison was made in the first "C. & C." motor, of making the field-magnet cores and coils about twice as long as necessary.

The first advertisement of an electric fan in the columns of the ELECTRICAL REVIEW appeared April 21, 1888, when the C. & C. Electric Motor Company, of New York city, advertised such machines with appropriate batteries to drive them in sizes of one-eighth, one-quarter and one-half horse-power, and stated that it was also prepared to make electric fans especially wound for use on electric light circuits. It was more than a year after this date before the first description of an electric fan appeared in the reading columns of this journal.

EMERSON FAN MOTORS.

The Emerson Electric Manufacturing Company, of St. Louis, Mo., manufactures electric fans for use on alternating currents. The accompanying illustrations give an excellent idea of the fan motors put out by this company for the season of 1901, and represent the three types known as wall, ceiling and bracket fans.

Referring to the illustrations, Fig. 4 shows a cross section of the armature and running parts of a desk fan. This machine is built with a one-half inch hardened steel shaft made of case-hardened tubing ground accurately to the size. The shaft, curiously enough, is stationary and is pressed into the back cover in a substantial manner, the armature revolving upon it and being held in place by a restraining screw at the front end of the tube, as is shown at I in the illustration. The armature does not rest on the hardened tube throughout its whole length, but is supported upon suitable bearings upon each end as shown at F, the space between the two bearings being filled with a lubricating compound, thus giving an ample supply to last through an entire season under ordinary circumstances. In addition to this supply of lubricant, the motor may be oiled by putting oil in the cup at A, which feeds both bearings through the centre of the hollow stationary shaft.

One of the most frequent difficulties encountered with fan motors is their liability to throw oil, and this has been elaborately guarded against in the motors of this type. It will be noticed by inspecting the illustration referred to above, that the screw-plug, C, entirely closes the hollow shaft at one end, while the screw-plug, I, at the other end is made loose enough to admit some oil to the retaining washer, H. This, however, is entirely covered by the cast-iron hub, J, thus entirely enclosing all the oil and making it impossible for the machine to throw any outside of its case. To prevent oil being thrown against the coils and other mechanism in the interior of the case, a leather washer at K, for sealing the hub, J, is provided, and a felt washer, D, and a rawhide washer, E, are provided at the rear end of the shaft for the same purpose.

It is especially recommended that these machines be oiled only once a year, as too much oil is as bad for them as too little, and if too much is put in it must come out somewhere.

The motor is of the induction type, the armature being short-circuited on itself,

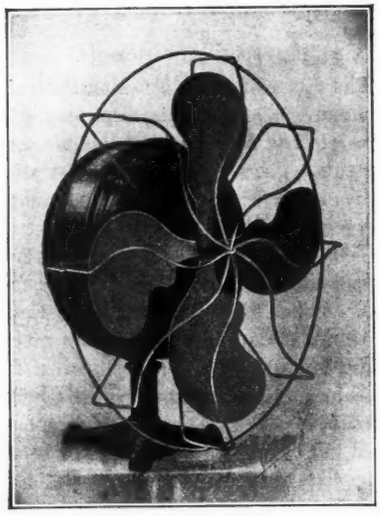


Fig. 1.—Emerson Desk Fan.

while the field is made with four energizing coils and eight poles, four of which are wound with coarse wire for the purpose of phase splitting and making the machine practically a two-phase machine fed from a single-phase source of supply.

The other illustrations show the various commercial models in which these fans are made. One of them shows a standard fan mounted on a swivel base and provided with three speeds of operation, this machine being made for 60 cycles per second. Another exhibits a ceiling fan for low-frequency currents, running at 210 revolutions normal and with a second speed of 160 revolutions per minute. This machine consumes 125 watts at full speed and 100 watts at the low speed. In Fig. 3 is shown a ceiling fan of a condensed type made for currents of higher frequency and working at speeds of at from 500 to 600 revolutions. The current consumption in this fan, as in the others mentioned, is 125 watts at full speed. Another illustration exhibits a special model of desk fan arranged with a swivel and trunnions for mounting it at any angle, the switch and regulating coil being mounted in the base of the machine. The current consumption on these desk fans of the size adapted for a 12-inch fan, varies from 45 to 80 watts, according to the speed of the fan, this ranging from 1,300 to 1,650 revolutions per minute for the various running points of the starting switch. In Fig. 5 is shown a bracket fan adapted to be attached to walls, while in Fig. 8 is shown a special model for low-frequency current desk fan. Fig. 6 exhibits a ceiling fan intended for low-frequency circuits and adapted to consume 100 and 125 watts at its two speeds.

All of the machines described above are wound for circuits of from 100 to 120 volts. It may be mentioned that the low-frequency desk fans are made with windings which the makers claim to secure extraordinary efficiency. They state that the watt consumption of the 12-inch motor of this type is under 55 watts, while considerably more breeze is stirred up by the motion of the older types consuming more current could produce. The same change of design has enabled the reduc-

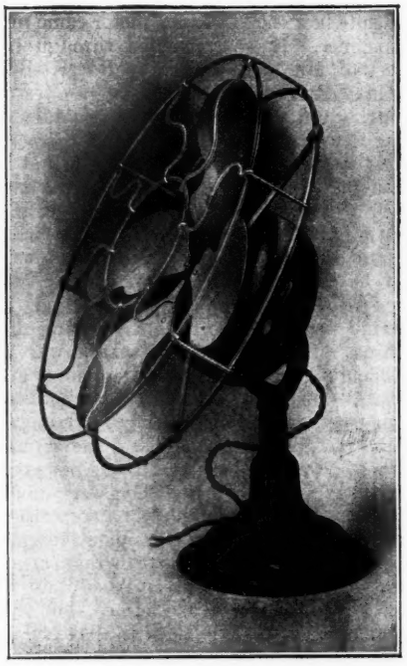


Fig. 2.—Emerson Special Swivel Desk Fan.

tion of the weight of the machine from 23 pounds to 17 pounds net. It is also stated that the power factor of the motor is very high, the 12-inch fan motor working at 104 volts consuming somewhat less than 0.75 amperes of current.

The ceiling fans described above are so arranged that electric light fixtures may easily be attached to them at any time.

WAGNER ELECTRIC FANS.

The Wagner Electric Manufacturing Company, of St. Louis, Mo., has for some time past discontinued the manufacture of ceiling and desk fans, but is still largely engaged in making motors for direct coupling to exhaust and other ventilating fans and motors especially adapted for belting to this variety of air-propelling apparatus. The accompanying illustration gives a view of the single-phase motor made by the Wagner company for the purpose and provided with cone pulleys for speed regulation. It is well known that the induction motor tends to remain as nearly as possible at synchronous speed, hence the necessity for using this method of regulation. The motor as may be seen from the illustration is compactly built, and is manufactured for the standard frequencies and voltages obtaining in electric light and power installations in the United States. The motors are self-starting and entirely automatic in their operation. They start by means of short-circuited brushes bearing upon a commutator connected to their windings, these being automatically thrown out of contact with the commutator when the machine has attained its speed. The starting torque is large and the efficiency of the machine is claimed by the makers to be very high both in operation at full load and at partial loads.

GENERAL ELECTRIC MOTORS.

For the season of 1901 the General Electric Company has prepared a complete series of fan motors for both direct and alternating-current circuits.

The alternating-current motors have no moving contacts. The cast-iron frame

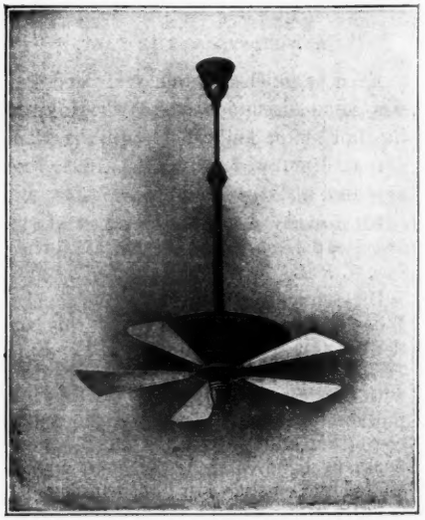


Fig. 3.—Emerson High-Frequency Ceiling Fan.

surrounds the armature of laminated soft iron with bare copper conductors, the field coils being mounted on a laminated-iron frame. The regulating device includes a three-point switch, which is placed in the back of the desk motors and in the base of the wall and bracket motors, and operated by a projecting key so that no additional switch is required. These motors will run at two different speeds. They are furnished for circuits of 60, 125 or 133 to 140 cycles and 52, 100 to 108 and 108

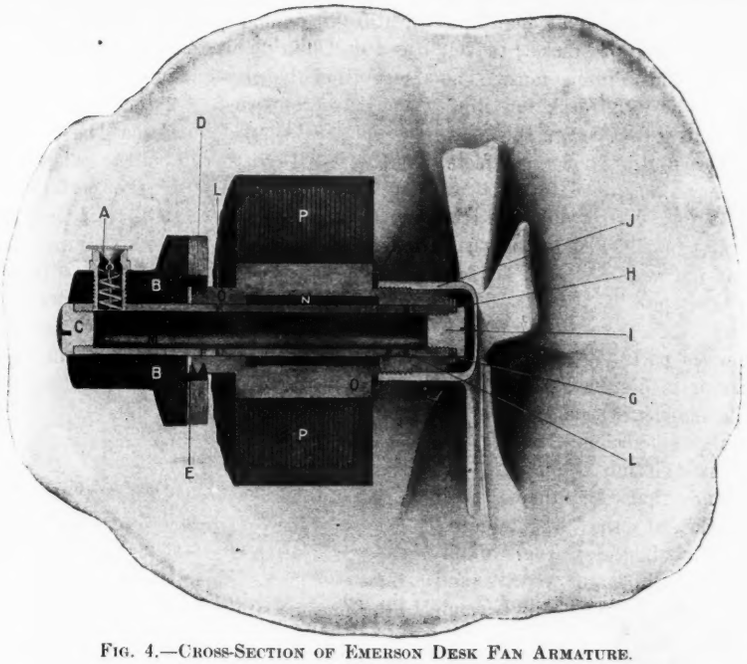


FIG. 4.—CROSS-SECTION OF EMERSON DESK FAN ARMATURE.

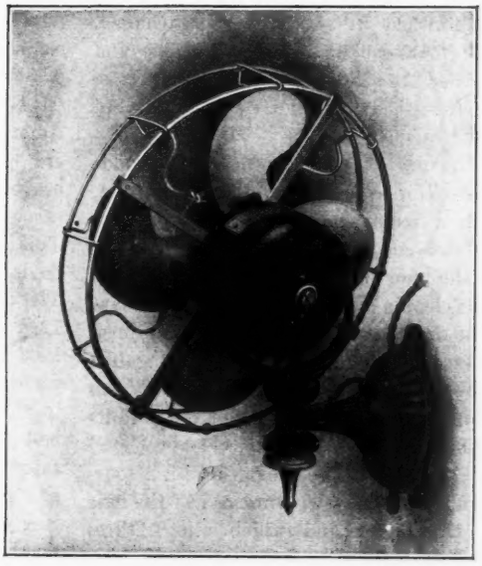


FIG. 5.—EMERSON BRACKET FAN.

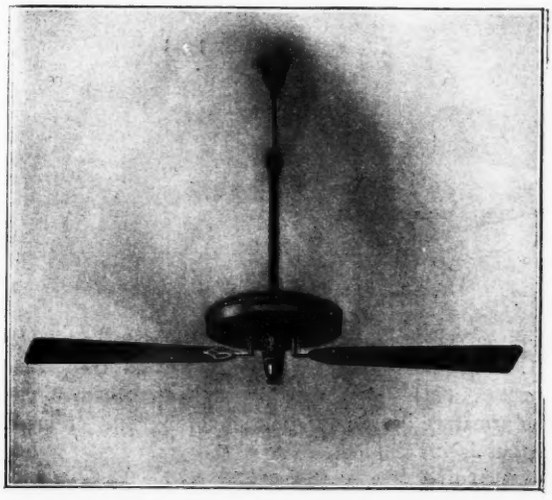


FIG. 6.—EMERSON STANDARD LOW-FREQUENCY FAN.

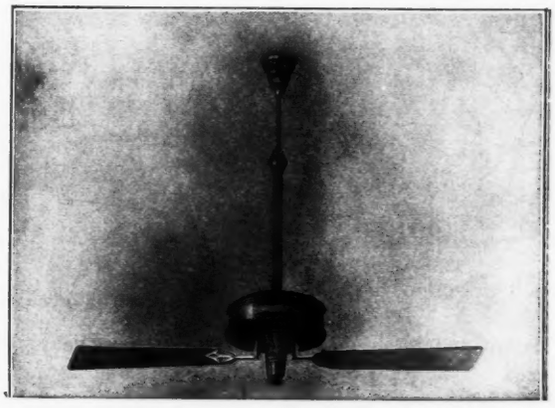


FIG. 7.—EMERSON SPECIAL LOW-FREQUENCY CEILING FAN.

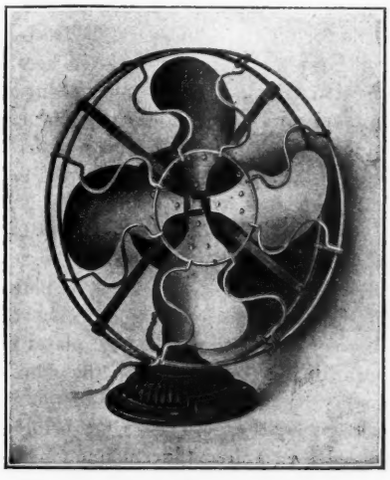


FIG. 8.—EMERSON LOW-FREQUENCY DESK FAN.

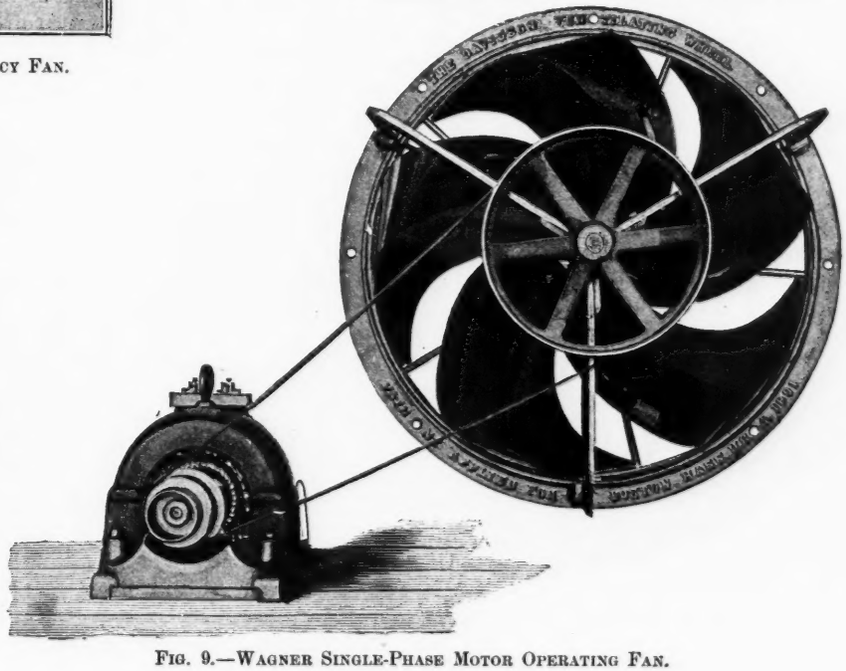


FIG. 9.—WAGNER SINGLE-PHASE MOTOR OPERATING FAN.

to 115 volts. On special order they can be supplied for 220 volts. The motors are finished in standard black enamel, with four-blade polished brass fans and polished brass guard and trimmings. They are furnished in three sizes, with 12, 14 and 16-inch fans.

The direct-current fan motors are made with elliptical bodies and are dustproof, with a removable shield over the commutator end which permits access to the brushes and brush holders for examination and cleaning. The brush holders have been designed so as to insure a uniform pressure of the rectangular brushes against the commutator and to prevent them from turning and presenting a sharp edge to its surface.

These motors are provided with a four-point regulating switch placed in the base of the motor and which allows three different speeds. The carefully proportioned bearings are lubricated by oil fed by a wick pressed against the shaft by a light spring. Direct-current motors are furnished with 12 and 16-inch fans.

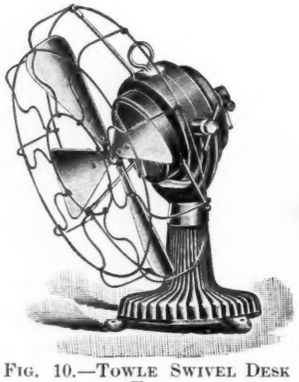


FIG. 10.—TOWLE SWIVEL DESK FAN.

The desk motors are furnished with solid frames, with swivel frames or with swivel and trunnion frames. Wall-bracket motors are furnished with swivel and trunnion frames.

The General Electric Company also manufactures a special wall-bracket motor of attractive design, for both direct and alternating-current circuits. This is furnished with either black Japan iron suspension frame, or, where more elaborate finish is desired, with brass arm and trimmings. As a convenience for persons desiring to use one wall motor in several rooms, this company supplies separate wall brackets on which the motors of a certain size and capacity are interchangeable.

The ceiling fans furnished are for use on direct-current circuits and are provided with either two, four or six blades, either slow or high speed.

TOWLE ELECTRIC FANS.

The George W. Towle Manufacturing Company, of Lancaster, Pa., manufactures an extensive line of bracket, swivel, duplex, ceiling, and column fans. The company's Eclipse swivel desk fan illustrated herewith is a new design this year. In Fig. 10 the fan is shown complete. Among the features claimed for this fan are the following: Two bolts hold the bearing in place, and by loosening these every part of the motor is disassembled. This allows the removal of the armature, fields, or any other part of the motor. The disassembled parts are shown in Fig. 12. The motor is designed to have the least possible magnetic leakage, thus insuring the highest efficiency. The casting for the 12-inch fan is made of the best iron, and that for the 16-inch fans is made of the best quality of cast steel. The external diameter of the 16-inch motor is five and one-half inches, which is exceedingly small and compact. The Towle company also makes two grades of ceiling fans. The company's new high grade Eclipse ceiling fan is shown in Fig. 11. This is equipped with a multipolar motor, and has a single field casting. The armature has 29 sections, and any coil that is injured may be replaced without rewinding the whole armature. The entire motor is encased in a polished brass cover, which may be removed readily by unscrewing the switch-button at the bottom of the motor. It will be noticed that this company's designs for 1901 represent considerable improvement over last year's types of fan motors. At present it confines its attention entirely to direct-current apparatus.

FIG. 11.—TOWLE CEILING FAN MOTOR.

FALCON FAN MOTORS.

The Falcon Electric Manufacturing Company, New York, has made few, if any, notable changes in its fan apparatus since last year. The changes that have been made have been mostly improvements in the finish of the exterior of the fan apparatus and in certain minor details of workmanship in its interior, which it is believed will give it longer life and better wearing qualities. The desk fan for direct-currents made by this company comprises an ingenious feature in its ability to be operated either as a desk fan of bracket fan. As will be seen from the accompanying illustration, the fan is supported by a stand containing a universal joint which may be firmly clamped with a thumb screw. The feet on which the fan rests are perforated with holes for screws so that if desired the base may be screwed to a wall and the fan motor part of the apparatus turned to any desired angle. The machines are made in both 12 and 16-inch sizes for the usual electric lighting voltages and also for operation at small voltages by batteries. In the pedestal of the fan is a resistance and regulating switch giving three speeds.

The peculiar point that is carefully looked after by the manufacturers of these fans is the mechanical balance of the fans and armatures so that smooth running may be secured. The machines are provided with radial carbon brushes and self-oiling bearings so that they are enabled to run throughout the entire season without attention or renewal of brushes or oil.

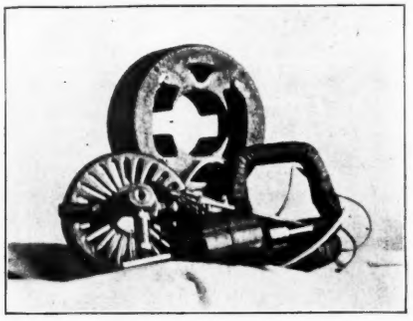


FIG. 12.—DISASSEMBLED PARTS OF TOWLE DESK FAN.

WESTINGHOUSE FAN MOTORS.

Little change has been made in the design of the Westinghouse Electric and Manufacturing Company's fan motors for the coming season. These machines are made for both alternating and direct-current circuits, the type illustrated here being that adapted for the alternating circuit only. The machine is an induction motor of small size, having an armature built of laminated-steel disks slotted to receive bare copper conductors.

Since the electro-motive force developed is very small, no insulation for these is needed and consequently there is nothing in the machine to burn out. The field ring is made of thin, soft-steel plates with inwardly projecting teeth, the familiar method of splitting the phase of the magnetic fluctuations of these rings being employed. Complete, the machine weighs 25 pounds, with its fan guard, fan and at-

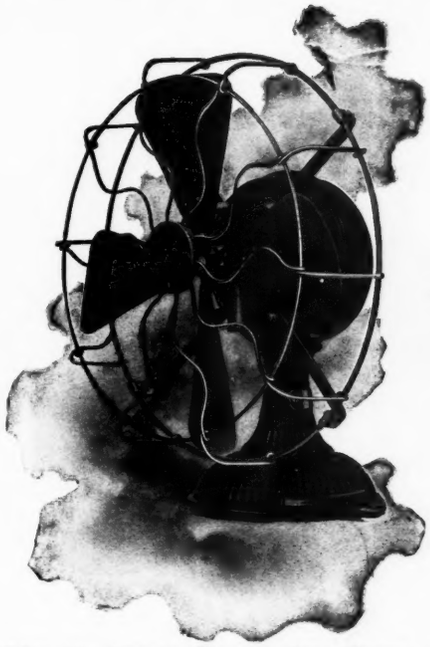


FIG. 13.—GENERAL ELECTRIC SOLID-FRAME DESK FAN.

FIG. 14.—GENERAL ELECTRIC ADJUSTABLE BRACKET ALTERNATING-CURRENT FAN.

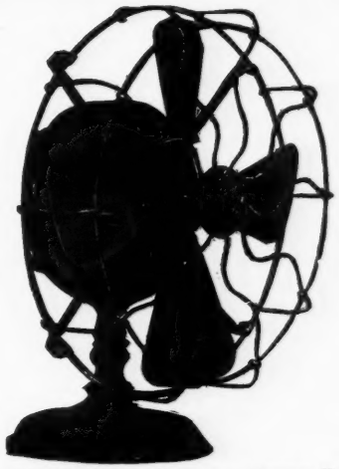


FIG. 15.—GENERAL ELECTRIC SWIVEL-FRAME ALTERNATING-CURRENT FAN.

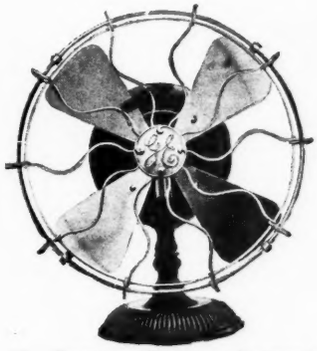


FIG. 16.—GENERAL ELECTRIC ALTERNATING-CURRENT DESK FAN.

FIG. 17.—GENERAL ELECTRIC SWIVEL AND TRUNNION-FRAME DESK FAN MOTOR, ALTERNATING CURRENT.

FIG. 18.—GENERAL ELECTRIC DESK FAN, SHOWING BRUSH-HOLDERS, ETC.

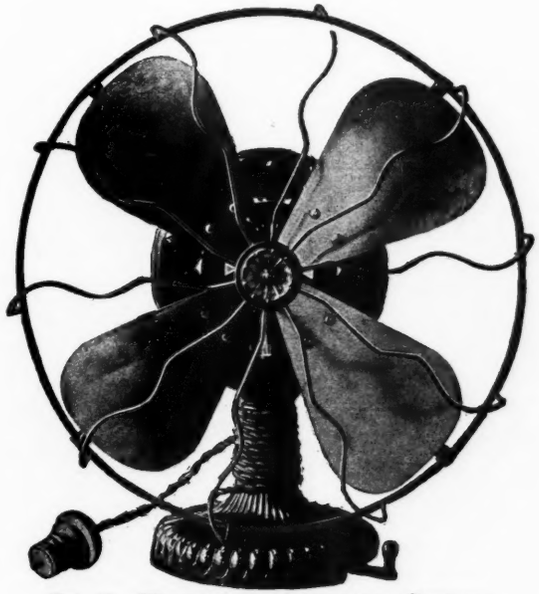


FIG. 19.—WESTINGHOUSE ALTERNATING-CURRENT DESK FAN MOTOR

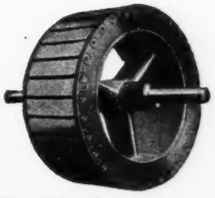


FIG. 20.—ARMATURE OF WESTINGHOUSE ALTERNATING-CURRENT DESK FAN MOTOR.

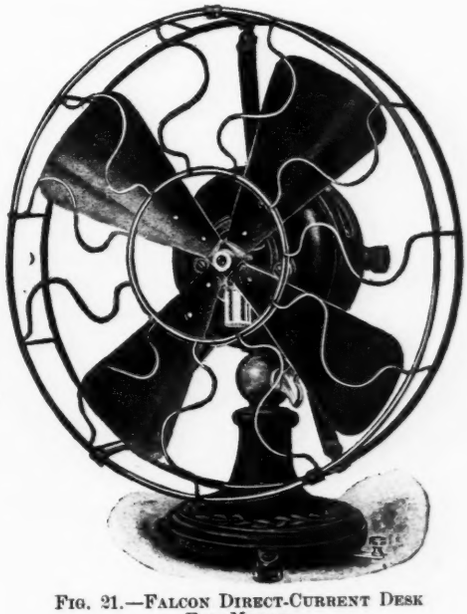


FIG. 21.—FALCON DIRECT-CURRENT DESK FAN MOTOR.

taching cord. The alternating-current motor is made to run at variable speeds, and is constructed for 50 and 100-volt circuits at from 60 to 130 cycles per second. At full speed the current consumption is approximately two and one-quarter amperes, and 0.75 ampere at half speed. The fan in these motors is four bladed, with a sweep of 13 inches. The general style of the motor may best be understood from reference to the illustration.

The direct-current motors made by the same company resemble somewhat in general appearance the alternating motors here illustrated, except that they are fully enclosed. The complete outfit weighs 23 pounds and is intended for 110-volt circuits. This machine operates under a current varying from one-fifth to one-half ampere, according to the speed at which it is operated. Both field and armature are laminated and speed variations are made by various commutations of the field winding, which is divided into parts for this purpose. The armature coils are wound in partly closed slots, protecting and supporting the winding and no band wires are used, strips of insulating material closing the slots in the metallic core of the armature and effectually preventing the wires flying up even at the full speed of the apparatus.

"PEERLESS" FAN MOTORS.

The "Peerless" desk and ceiling fan motors for use on direct-current circuits are manufactured by the Warren Electric and Specialty Company, of Warren, Ohio. Several types of this company's fans are shown in the accompanying illustrations. For the season of 1901 this company has produced two entirely new designs in ceiling fans, in which nearly every feature is believed to be a distinct improvement. An especially large number of new devices have been incorporated in the design of the company's standard ceiling fan, which it designates as "Type H Ceiling Fan." Among the improvements made, the manufacturers mention a new and better design of fan blade, as well as a new regulating device, bearings, oiling device, switch-key, and field coils. The fan blades revolve at an increased speed, an improved electrolier attachment is provided, and the makers guarantee a higher efficiency than in previous fans of this type. The blades of the fan are full 60 inches sweep, and are suspended from below the motor.

The Warren Electric and Specialty Company is also bringing out this season a midget ceiling fan known as its "Type K 1," which is illustrated herewith. This has a sweep of only 24 inches, but has a

FIG. 22.—"PEERLESS" STANDARD CEILING FAN.

FIG. 23.—"PEERLESS" MIDGET CEILING FAN.

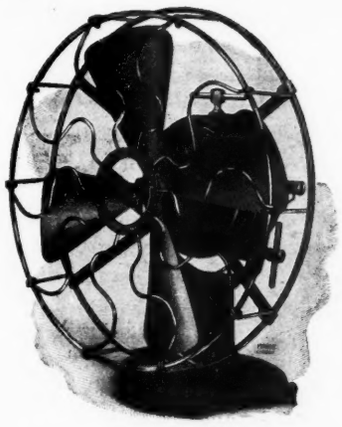


FIG. 24.—PEERLESS TRUNNION AND SWIVEL DESK FAN.

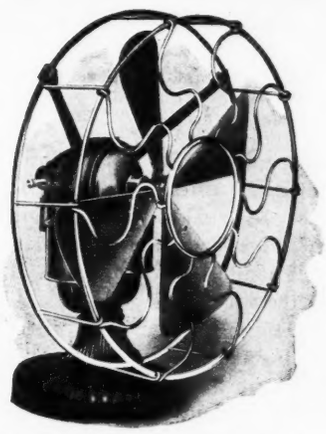


FIG. 25.—PEERLESS RIGID IRON-CLAD DESK FAN.

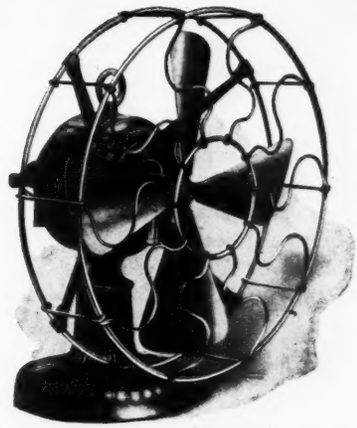
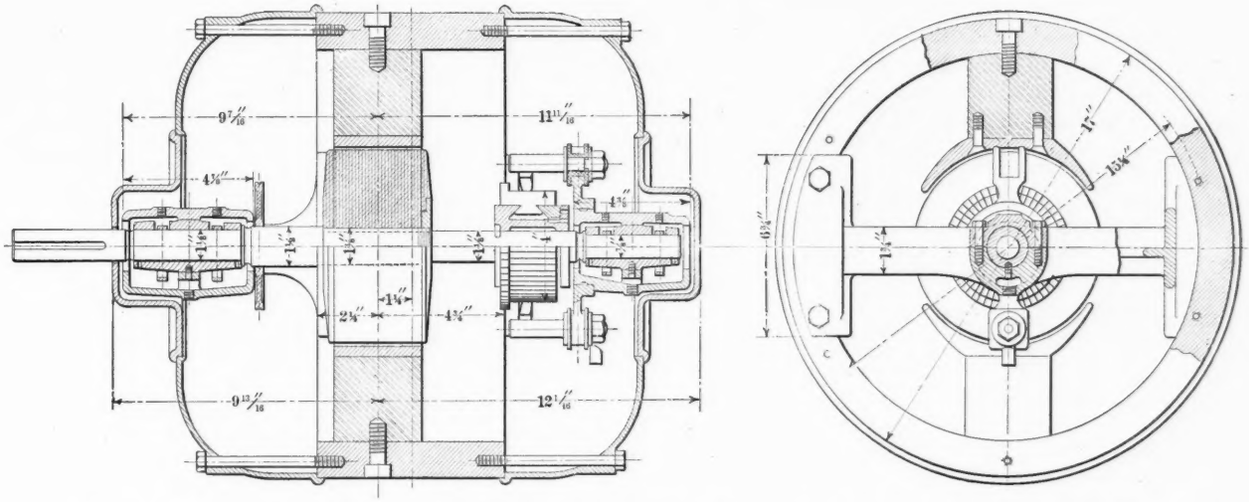


FIG. 26.—PEERLESS ADJUSTABLE SWIVEL DESK FAN.



FIGS. 27 AND 28.—AXIAL AND TRANSVERSE CROSS-SECTIONS TO SCALE OF STURTEVANT ENCLOSED MOTOR FOR LARGE FANS.

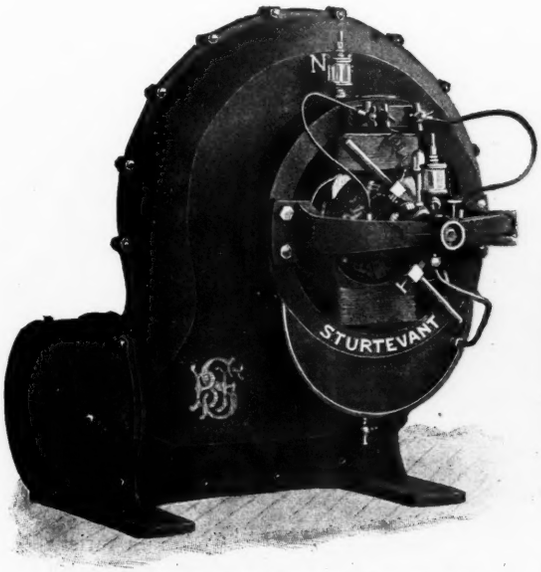


FIG. 29.—STURTEVANT BIPOLAR BLOWER FAN.

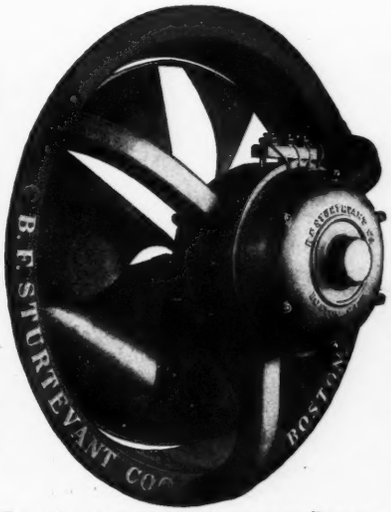


FIG. 30.—STURTEVANT PROPELLER EXHAUST FAN MOTOR.

FIG. 31.—STURTEVANT BLOWER DIRECT-COUPLED.

speed of 500 revolutions per minute, and is claimed to run on a very small consumption of current. The company also manufactures three types of desk fans known as "Types A, E and G." Type A, is an open field fan, which has the following new features: Improved guards, guard braces, blades, oiling device, bearings, and brush holders. Type A1 is an adjustable swivel fan. Type E, is a trunnion fan with a swivel adjustment, and enclosed fields; it is of the iron-clad type. Type G is a rigid iron-clad fan. With the exception of type G, all the "Peerless" desk fans are equipped with a regulating device, which gives three distinct speeds. The changes of speed are clearly indicated on the fan base.

STURTEVANT FANS.

The B. F. Sturtevant Company, of Boston, Mass., does not manufacture small fans, but makes a specialty of the construction of electric ventilating apparatus of a somewhat larger size. The preceding illustrations exhibit some of its air-propelling mechanisms, and the detailed structure of the enclosed type of electric motor used in connection with its propeller fans. The field ring of the motor is of wrought-iron, bolted to lugs projecting from the side of the fan. The construction of the apparatus may most easily be understood from an inspection of the accompanying scale drawings showing a transverse and vertical cross-section of the motor. The armature, as the drawings show, is of the drum-wound type, the shaft running through the ring-oiler bearings suspended in yokes projecting from either side of the field ring. At the two ends of the armature core are cast-iron flanges supporting, as well as protecting, the projecting ends of the coil of the windings. The core is deeply perforated for ventilation and the smooth interior of the armature flange and of the core openings offer no opportunity for the collection either of oil or dust. The brushes are made of fibre graphite carried by reaction brush-holders. It may be mentioned that this type of motor was designed to fulfill the difficult specifications in regard to heating, it being required to run 10 hours at full load on a temperature rise of not more than 90 degrees, and not to spark at 25 per cent overload. Other illustrations show centrifugal fans direct-coupled to motors.

HUNTER FANS.

Little, if any, change has been made by the Hunter Fan and Motor Company in its alternating-current ceiling fans for the coming season. It is expected that the speed of the 40, 50 and 60-cycle varieties will be raised from 152 to 175 revolutions per minute, while maintaining the length and width of the blades the same as heretofore.

BATES FANS.

Among the fans manufactured by Messrs. D. L. Bates & Brother, Dayton, Ohio, may be found both the desk and ceiling styles for direct and alternating currents. The illustrations give an excellent idea of these machines.

Referring to the four-blade, direct-current ceiling fan, the current consumption is claimed by the makers to be as small as 85 watts. These machines are wound for 110, 167, 220, 250 and 500 volts, the object of the odd windings, 167 and 250 volts, being that fans thus constructed may be connected, respectively, three or two in series on a 500-volt circuit. In these fans the commutators are of hard copper with mica insulation, and the armature is fitted with form wound coils, as is well shown in the small illustration. Owing to the shape of the slots and the nature of the winding no banding wire is required, as the coils hold one another in place. This construction also enables easy repairs, as the damaged coil may be cut and taken out and a new one put in place by any competent electrical mechanic. The field magnet is composed of soft cast-iron, and is wound with formed coils insulated with micanite.

Automatic lubrication is supplied to the bearings of these fans, which run throughout a season without reoiling. The brushes are made of a special grade of carbon, cylindrical in form, and are forced into contact with the commutator by means of spiral springs. Being placed at the bottom of the motor casing, their renewal is easily and quickly made when it is required.

The desk fan made by this company for direct currents is a bipolar motor of the simplest form. The current consumption claimed is 31 watts with a 12-inch fan at full speed. The fields are constructed of steel, drop-forged, and all of the working parts of the motor are carefully enclosed to prevent dust from gathering in them. The motor is made both in desk and bracket forms, the latter being provided with a ball-and-socket attachment, so that the fan may be readily adjusted to throw air in any desired direction.

The same concern manufactures induction motor desk fans for single-phase alternating current of the two standard frequencies. These machines, it is stated, run with a current consumption of only 50 watts, and it is said that their power factor is very high on account of the absence of phase-splitting or starting coils permanently in circuit. The motors are started by means of a starting switch attached to the back of the case.

THE BACKUS ELECTRIC FANS.

The ceiling fan shown in Fig. 38 is one of the products of the Backus Water Motor Company, of Newark, N. J., who have a reputation extending over several years for their standard fans of this type, and of the column type operated by electric motors. They are designed for use on direct currents at the usual standard voltages from 110 to 500 volts and all are constructed so that two speeds may be had by simply turning a switch. If desired, the switch may be attached to the lowest point of the fan case. In the construction of the motor a hollow steel shaft is used through which passes a stationary steel rod attached to a switch at the top. The motor has but this one bearing, which is lubricated by means of grease, put in when the fan is shipped from the factory. The manufacturers state that it is impossible for the grease to escape under any circumstances. No oil, therefore, is required in the operation of the fan. In the type illustrated the body is of brass and is supplied in a number of different finishes. The blades are set at an invariable angle determined by experiment as the best for general service and a simple turn of the button at the lowest part of the case starts the fan at slow speed, increases it to high speed, or stops it. The improvements made in the Backus fans for the season of 1901 include an improved laminated-steel armature which is considerably lighter than the one used in last year's design. It is so constructed that it will not heat up and affords an increase of running speed as well as operating on lower current consumption. The whole fan is of lighter construction, although the outside appearance remains about the same.

DIEHL ELECTRIC FANS.

The Diehl Manufacturing Company, Elizabethport, N. J., was one of the pioneers in the construction and exploitation of electric fans. It early turned its attention to ceiling fans, or the slow-speed type of wind-propelling apparatus employing the familiar two wooden blades sweeping around in a horizontal plane and suspended from a fixture attached to the ceiling. In the accompanying illustrations are shown some of the modern and highly-developed types of this style, as well as desk fans made by the same company.

The ceiling fans are made in a variety of styles for direct current, the major

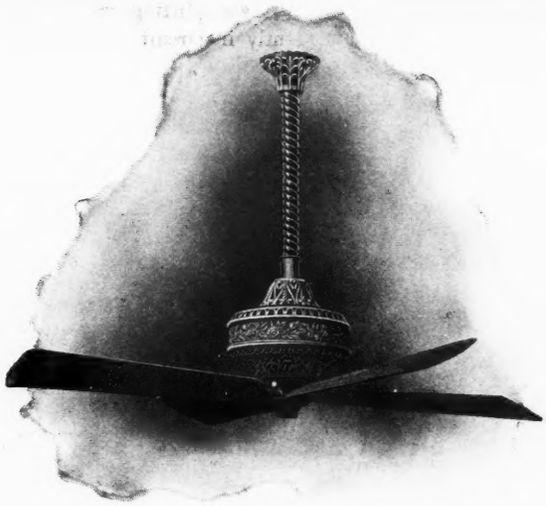


FIG. 32.—BATES CEILING FAN.

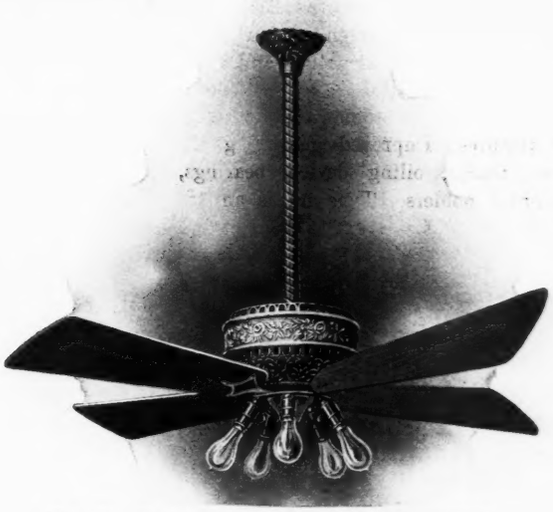


FIG. 33 —BATES CEILING FAN WITH ELECTROLIER.

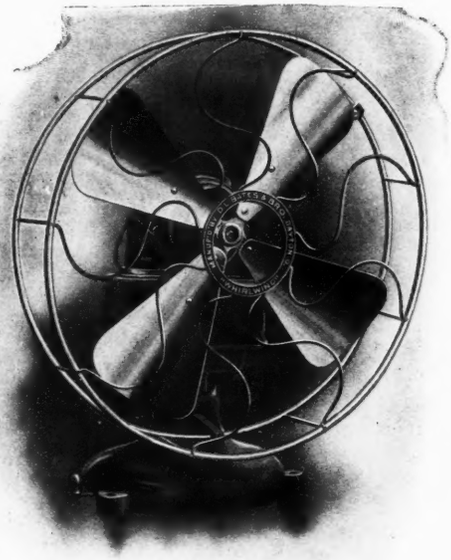


FIG. 34.—BATES DIRECT-CURRENT DESK FAN.

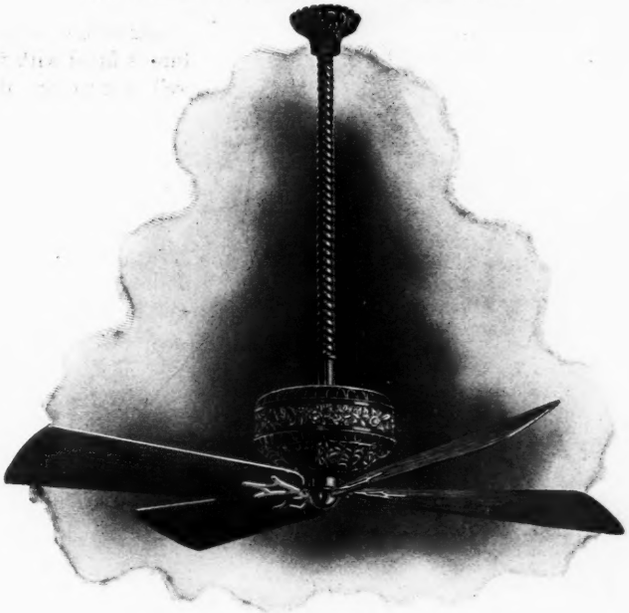


FIG. 35.—BATES CEILING FAN.

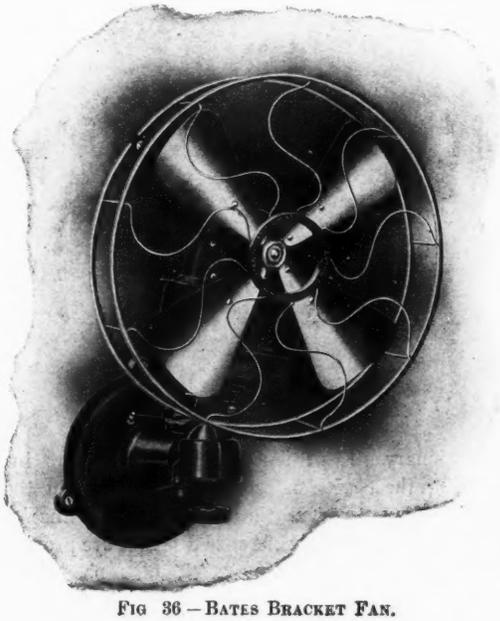


FIG 36 — BATES BRACKET FAN.

FIG. 37.—BATES DESK FAN ARMATURE.

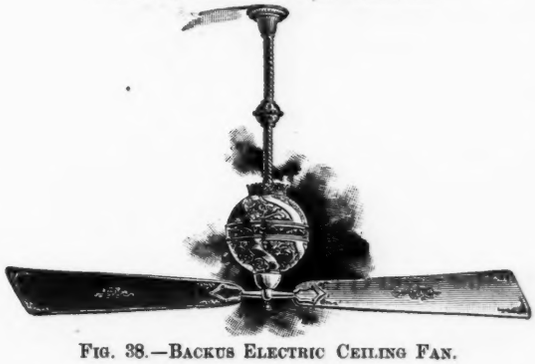


FIG. 38.—BACKUS ELECTRIC CEILING FAN.

differences between these being in their external finish and appearance, and in their winding for currents of various voltages. Both the armature and field cores are laminated and are made of sheet charcoal iron. The commutator is of a flat type, having radial bars, and is located on the under side of the armature wound for 110, 220 or 500 volts, and also for direct-current, series arc circuits of the standard amperages. The ceiling fans have a sweep of 60 inches from tip to tip of their blades, and are controlled either by switches located on the wall of the room in which they are set, or in the lower part of the fan casing, thus easily within reach of a person standing on the floor under the fan. It will be noticed that one of the ceiling fans is provided with a fixture for five incandescent lamps; these, of course, remain stationary while the fan part rotates. During the Winter time the blades of the fan may be removed, thus leaving the apparatus an ornamental and serviceable lighting fixture.

The special claim made by the manufacturers for their desk fans is high efficiency. The two field cores are cast integral with the iron frame of the apparatus, thus making an unbroken magnetic circuit. The armature is deeply slotted and is wound with double silk-covered copper wire, while the commutator is of hard-drawn copper bars insulated with mica and built much in the same way as those of large machines. Self-aligning bronze bearings are provided with self-feeding wick oil-cups, which hold sufficient oil to provide for a season's to prevent the accumulation of dirt and dust upon it. Arrangements for oiling have been carefully designed and improved by the results of experience, until it is not necessary to oil these machines oftener than once a year. The fans are

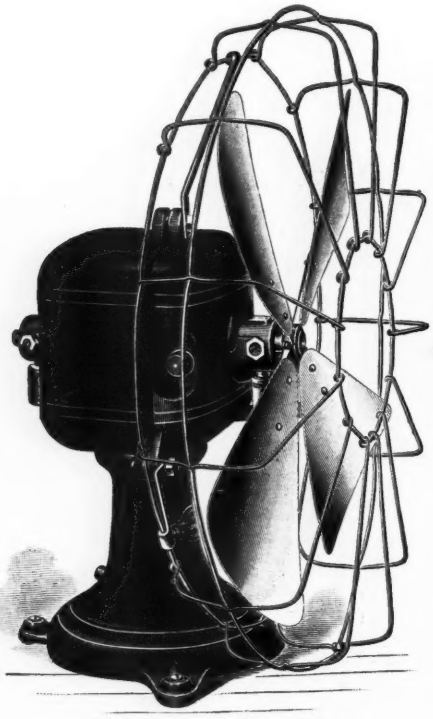


Fig. 39.—Diehl Desk Fan.

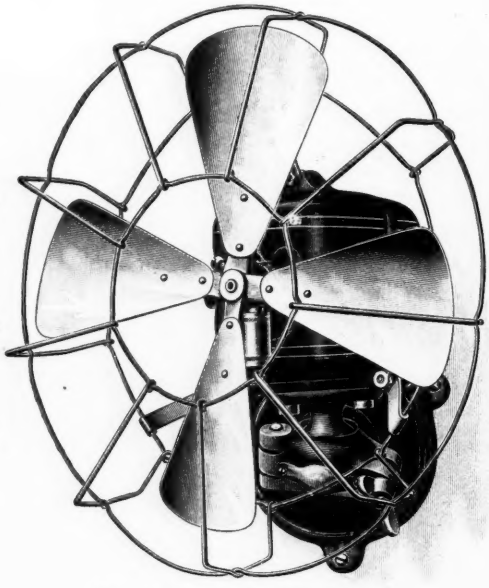


Fig. 40.—Diehl Bracket Fan.

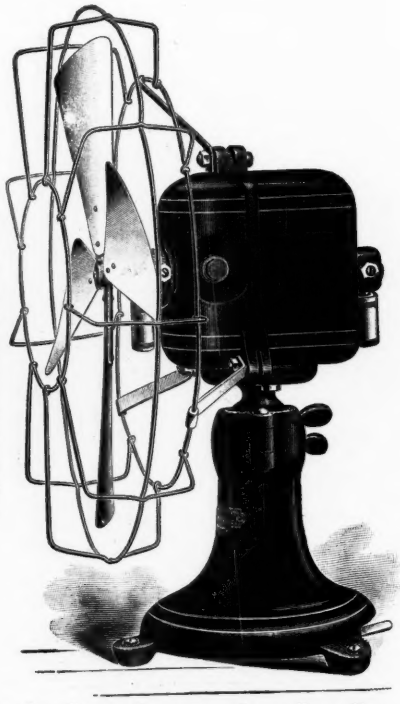


Fig. 41.—Diehl Universal Joint Desk Fan.

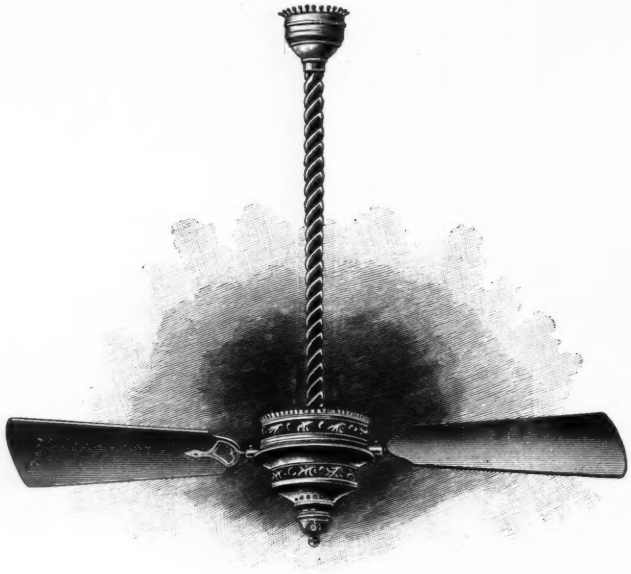


Fig. 42.—Diehl Ceiling Fan.

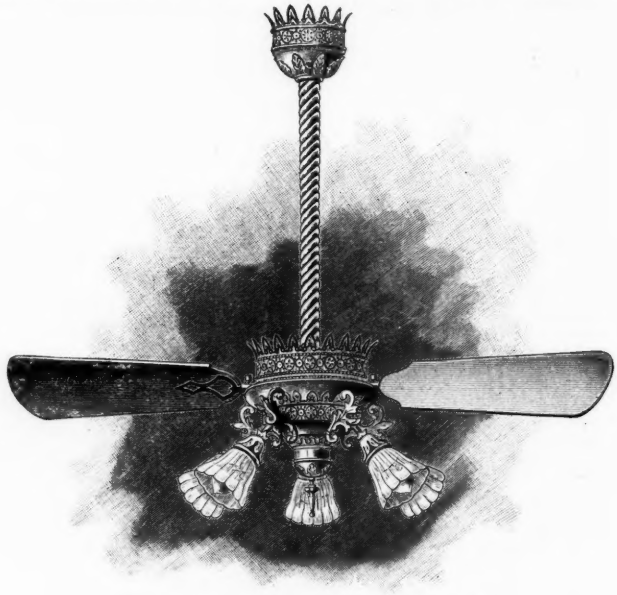


Fig. 43.—Diehl Electrolier Ceiling Fan.

running. The brush-holders, which are on the side of the frame nearest the fan, are of a special design, no external wires being visible, and feed radially carbon brushes which are sufficient to last more than one season of steady use. Both the 12 and 16-inch sizes are provided with a three-point starting switch in the base, giving three speeds. The larger fan is wound for 110, 220 and 500-volt circuits, though the smaller size is not made for the higher voltage.

FIG. 44.—"C. & C." EXHAUST FAN COMBINATION.

FIG. 45.—"C. & C." SERIES-PARALLEL MOTOR AND BLOWER.

Another figure illustrates an interesting variation in the design of desk fans. The base is provided with a universal joint so that the motor and fan may be placed in any desired position, thus permitting wide variation of the stream of air given out by the fan. The same company is also engaged upon making small types of fans for use in telephone booths and other small and close situations, such as steamer staterooms, where the demand for ventilation is satisfied by a small and gentle current of air.

C. AND C. FAN MOTORS.

The C. & C. Electric Company, New York, was probably the pioneer in electric fan work. For many years it manufactured increasing numbers of small fan motors, but of late has abandoned this line of work to take up the construction of larger motors, among them being those especially adapted for direct coupling with large ventilating fans. Several varieties of these motors are illustrated herewith, among them some interesting types of motors embodying the company's series parallel system of control. This method employs two commutators and two separate windings on the armature of the motor, these being worked in series and in parallel and in combination in various ways with the field windings of the motor. The lowest speed, for instance, is obtained with the two armature windings in series with one another, and with the series field; the highest speed is obtained with the armature windings in parallel and the series field winding short-circuited upon itself. In connection with this system is provided a controller so constructed that movements of a single lever are sufficient to control all of the functions of the fan.

In modern ventilating installations it is found necessary to graduate the speed so as to deliver greater or less volumes of air, this being especially true with machines operating in connection with heating and ventilating systems.

Another interesting type of large fan motor is the vertical machine shown in one of the illustrations and adapted particularly for air-shaft ventilation. For this variety of work, a propeller fan, revolving in a horizontal plane, is employed and coupled through any convenient length of vertical shafting to the motor below. A large number of such installations have lately been put in in New York city. Other illustrations show the type of semi-enclosed motor manufactured by this company for direct coupling to exhaust fans for ventilation in the usual way employed in restaurants, kitchens, railway stations and other large apartments.

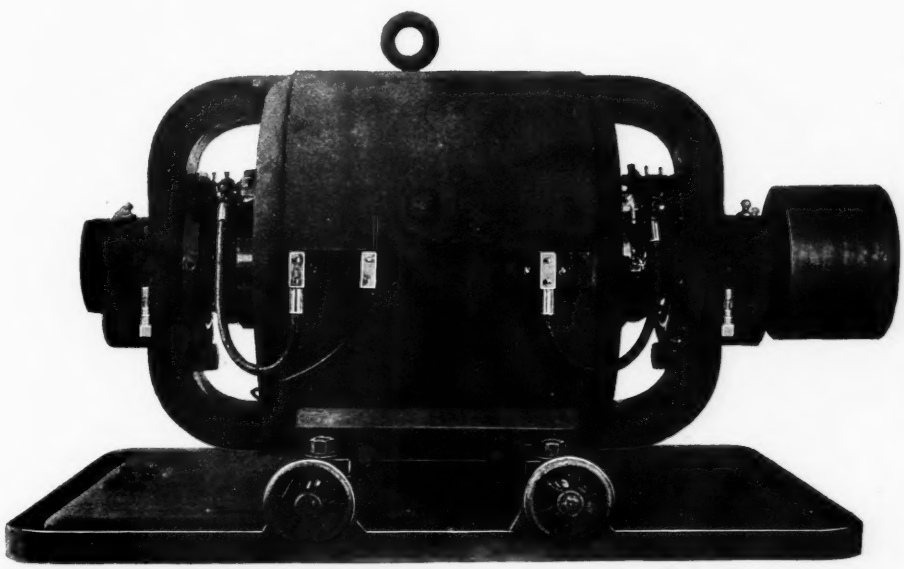


FIG. 46.—"C. & C." SERIES-PARALLEL MOTOR FOR FAN WORK.

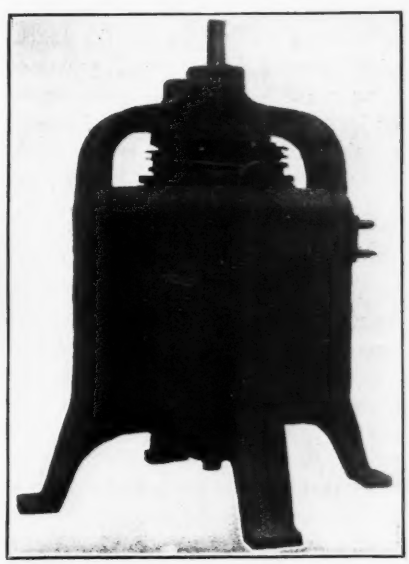


FIG. 47.—"C. & C." VERTICAL MOTOR FOR AIR-SHAFT FANS.

ROBBINS & MYERS STANDARD FANS.

The Robbins & Myers Company, of Springfield, Ohio, manufactures direct-current ceiling and desk or propeller fans which are well known in the trade. A characteristic of these machines is the

great care which has been paid to their mechanical design. The new designs for 1901 of this company's fans are not yet ready for description, but it is understood that they will embody several novelties and improvements over those that were offered last season, and that they will shortly be placed upon the market.

WESTERN ELECTRIC FANS.

The Western Electric Company, Chicago and New York, has been for several years a large manufacturer of direct and alternating-current fan motors of the usual types. No great change has been made in the design of these motors since last year, the experience of the Summer season of 1900 having shown that little change was required. Referring to the accompanying illustrations, the cross-sectional view of the working parts of a desk fan motor is of great interest. It will be noticed that the machine has a U-shaped two-pole field, and a drum-wound armature mounted directly upon a straight, steel shaft. This runs in self-aligning bearings, shown at A, which are lubricated automatically and continuously by the oil-cups, B, a wick in the oil-cup being pressed lightly upward by a spiral spring as shown. These cups contain sufficient oil to last through a full season's operation of the fan. The magnet frame is a drop forging, and is held to the base by the bolt, E, so that the machine may easily be removed by unscrewing a single bolt. It will be noted from the illustration of the armature that the slots are very narrow at its circumference, forming effectually an ironclad armature and fully protecting the wires against mechanical injury. In motors of this type the commutator is open to view and injurious sparking of the brushes may be corrected before it has done irreparable damage. The brushes used are of specially prepared graphite and are carried in self-adjusting holders. In the base of the fan motors of this type is a switch giving three different speeds by means of cutting in or out resistance wound on the porcelain spool,C, in the base of the machine. These motors are made for 110, 220 and 500 volts, the latter having a double-pole quick-break switch placed beneath its frame. Great care has been taken in experimenting with the shape and pitch of the fan blades to secure the highest efficiency in wind-propelling machines of this sort. Another illustration gives an excellent idea of the appearance of the complete desk fan motor.

Another cross-sectional view shows the working parts of a direct-current ceiling fan motor made by the same company. It will be noticed that the self-aligning bearings and armature are like those of the desk fan. Most elaborate care has been taken in this machine to prevent oil accumulating at the upper bearing from running down upon the armature. In the frame of the machine, at D, is a porcelain spool wound with German silver wire, which is used as a speed controlling rheostat for giving the fan three speeds of operation. The machines are built with four blades, and are wound for 110, 170, 200, 220 and 500 volts, the latter working up to 550 volts without difficulty. The sweep of the fans in these machines is 60 inches, and they are fixed in a permanent position which has been found in practice to be the best. The wires for the chandelier lights below the fan and the double silk and rubber-covered cable connecting

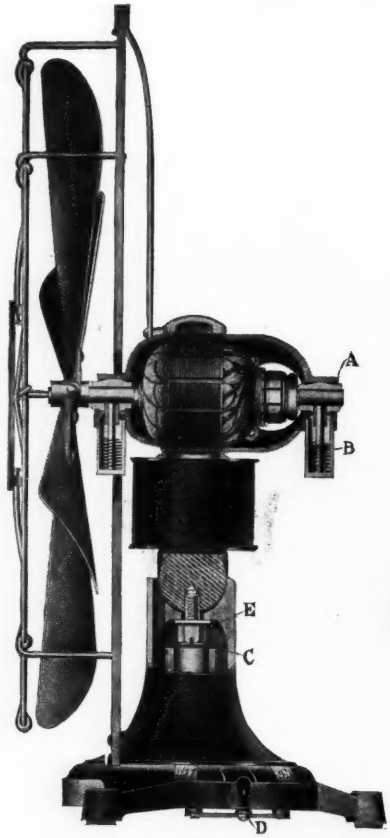


FIG. 48.—WESTERN ELECTRIC DESK FAN, CROSS-SECTION.

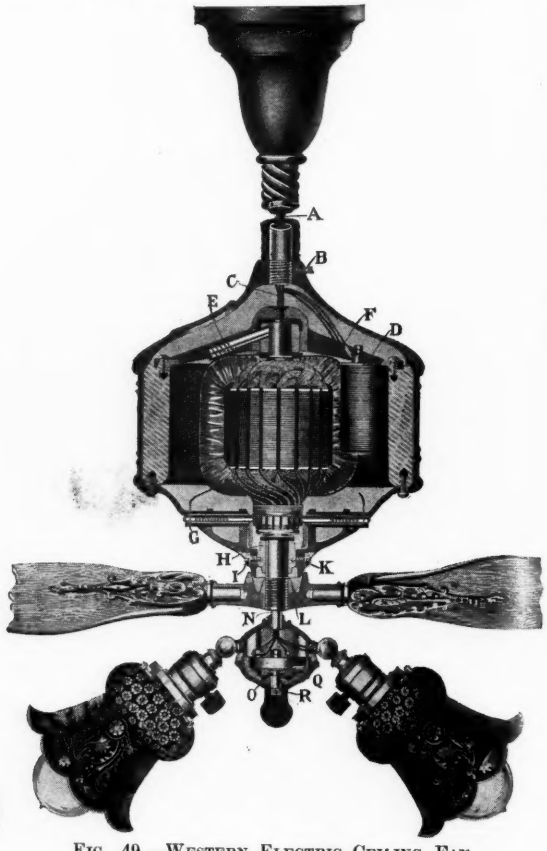


FIG. 49.—WESTERN ELECTRIC CEILING FAN, CROSS-SECTION.

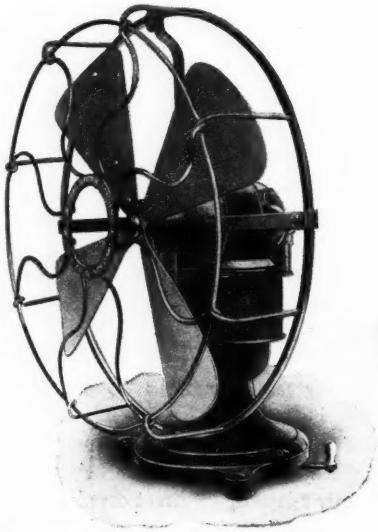


FIG. 50.—WESTERN ELECTRIC DESK FAN.

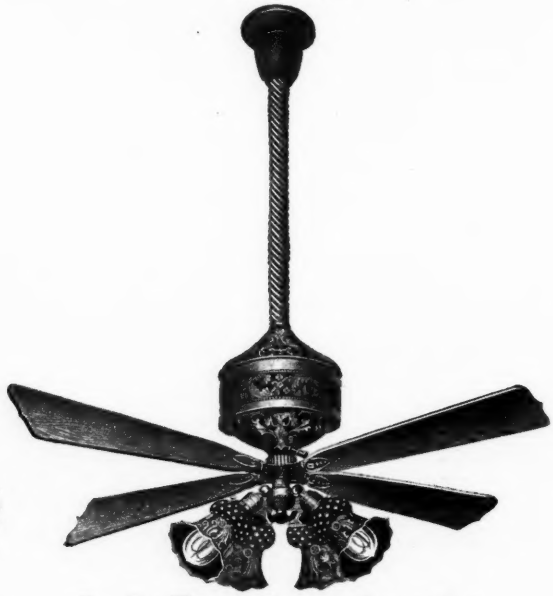


FIG. 51.—WESTERN ELECTRIC CEILING FAN.

the speed rheostat with the switch are run through an iron pipe passing through the centre of the hollow steel shaft of the machine, this being well shown at N in the

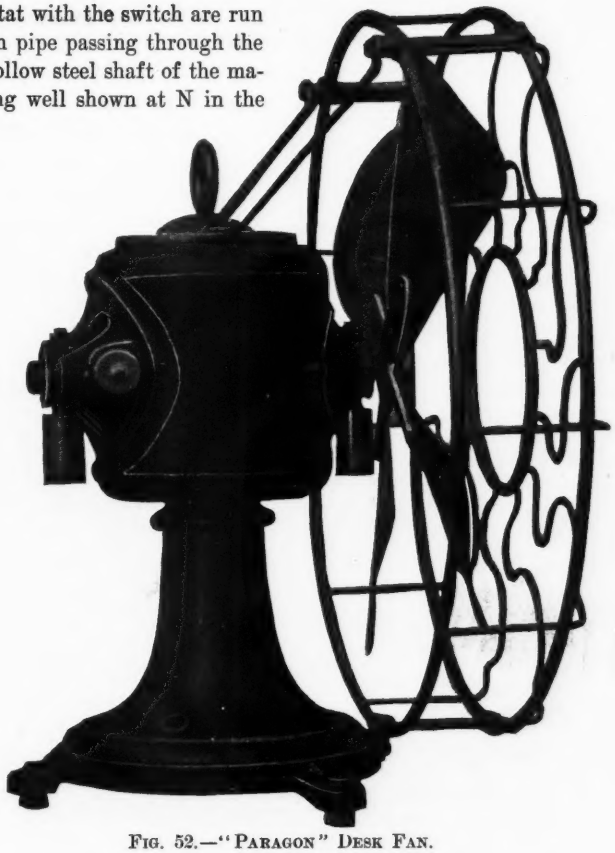


FIG. 52.—"PARAGON" DESK FAN.

drawing. Another illustration gives an excellent idea of the appearance of a ceiling fan of this type.

In addition to the fans described and small battery fan motors, the same company manufactures alternating-current desk and ceiling fans.

PARAGON FANS.

"Paragon" fans, manufactured by the Paragon Fan and Motor Company, New York, are appearing in a number of improved styles to meet the demand for goods of this character. The illustrations show desk and bracket fans for direct current and a very interesting cross-section, in part, of the mechanism of the ceiling fan.

In the desk and bracket types and the trunnion or dirigible fan, the resistance in use for speed control is of a standard enamel form. In the ceiling type an enamel resistance of the tubular form is also used, as is seen at E in the sectional drawing. In both the varieties of fans employed lubrication for a season's run is provided by grease or oil-cups. In the ceiling-fan section these are shown at F and G. It is claimed by the makers that these fans drive a standard set of 50-inch blades at 175 revolutions per minute on a current consumption of 92 watts.

The desk and bracket fans are wound for from 110 to 250 volts, each variety of winding being, however, adapted to operate successfully on voltages within five per cent of its rating. The consumption of the 12-inch fan at 1,700 revolutions per minute, and from a 115-volt circuit is 0.39 ampere or a trifle less than 45 watts; under the same circumstances the 16-inch fan consumes 69 watts when running at its full speed of 1,500 revolutions.

FIG. 53.—"PARAGON" TRUNNION FAN.

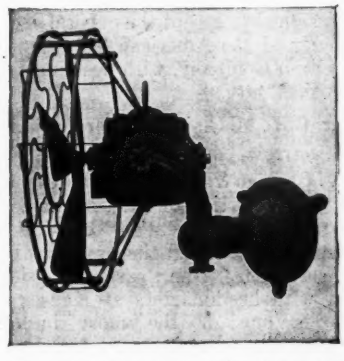


FIG. 54.—"PARAGON" BRACKET FAN MOTOR.

The armatures and commutators of these fans are built up under hydraulic pressure, this method of construction being claimed to be highly effective and, especially in the commutators, to result in a solidity of structure that is unparalleled. Rectangular carbon brushes are used so that, unlike the cylindrical brushes which have been much employed, they can not turn around in the holders, but when once fitted must maintain an even contact over their whole area. Wick-feed oilers of a new design have been adopted in connection with self-aligning phosphor-bronze bearings and in addition a retaining chamber has been added, effectually preventing any oil from reaching the commutator or brushes. The body of the desk fans is made in a single piece, thus avoiding all magnetic joints and by

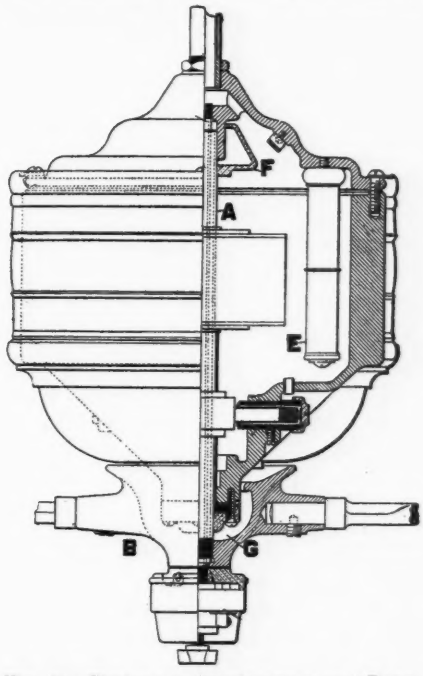


FIG. 55.—DETAILS OF CONSTRUCTION OF "PARAGON" CEILING FAN MOTOR.

the removal of only two screws the entire front of the machine, including the brush-holders, may be taken out, exposing the interior.

Ceiling fans are made in a large number of styles and varieties, including a 24-inch, short-standard, high-speed, two-bladed fan for use in small interiors, the fan speed being 650 revolutions under a consumption of 45 watts.

DAYTON FANS.

All styles of fans, for both direct and alternating currents, are made by the Day-

ton Fan and Motor Company, of Dayton, Ohio. One of the most interesting types of this company's smaller fans is a wall swivel mounting. A vertical shaft carrying a fork in which the fan motor swings on trunnions turns on a vertical shaft socketed in an ornamental casting. Many fans have been made by this company for export. The various types of wall, desk and ceiling fans constructed by it are made for all the frequencies and pressures in ordinary use.

BOSTON ELECTRIC HEATING AND POWER COMPANY'S FANS.

The Boston Electric Heating and Power Company, of Boston, Mass., has just placed on the market a "ventilating chandelier," being an improved type of fan with lighting attachments, and also a novel design of desk fan.

The sweep of the ventilating ceiling fan is less than half the diameter of that of the fans in common use, and the shape of the blades is claimed to secure an excellent distribution of air.

It is claimed, also, for the desk fan, that, while the diameter of its fan is 12 inches, the air set in motion is not the usual cylindrical breeze that comes from such an apparatus, but a distributed current reaching a diameter of 10 feet at a short distance from the fan. It is also stated that the construction of the blades insures the least possible noise when running at high speeds.

LUNDELL ELECTRIC FANS.

The Sprague Electric Company, New York, has for some time manufactured the Lundell electric fan, well known as one of the first enclosed types of direct-current fan motors, and one which at the time of its introduction won general and widespread favor on account of its electrical excellence and general mechanical simplicity and ingenuity of design. For the season of 1901 little or no change will be made in the Lundell motors, their features being the use of the single field-coil, energizing both poles, and great care in the mechanical construction of the apparatus. It is claimed by the makers that the current consumption of a 12-inch fan running at its highest normal speed is only 0.45 ampere at 115 volts.

PERSONAL.

Mr. Alexander Cochrane, acting president of the American Telephone and Telegraph Company, of Boston, is spending a few weeks' vacation in the South. A report from Boston is to the effect that a permanent president of the company will be elected before March 1.

Mr. E. Henry Barnes, of New Haven, Ct., has been elected a director of the Boston Electric Light Company, of Boston, Mass., succeeding the late Frederick A. Gilbert. Mr. Sidney Hosmer has been elected general manager of the company. The office of president has not as yet been filled.

Mr. Edwin Burhorn, M. E., has established an engineering and contracting business on his own account at 62 Wall street, New York city. Mr. Burhorn is a specialist in designing and erecting steam and electric plants, and announces that he desires cases offering unusual difficulties.

Mr. Frank E. Rowell, of Kittery, Me., died from the effects of a severe attack of pneumonia on the night of January 27, in his home on Badger's Island. He was well known as the promoter and organizer of more than 500 companies, and at the time of his death held the clerkship of 400 of them. Mr. Rowell was also treasurer of the Portsmouth, Kittery & York Street Railway Company.

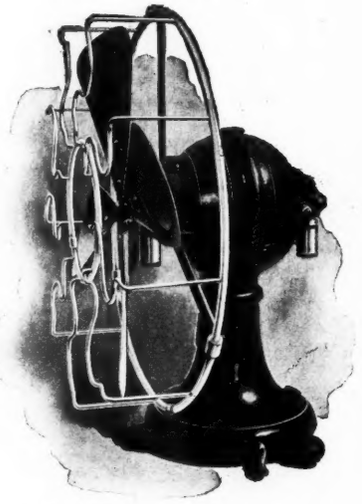


FIG. 56.—LUNDELL DESK FAN.

Mr. W. T. Gentry, of Atlanta, Ga., was elected general manager of the Southern Bell Telephone Company at the recent directors' meeting of that corporation in Atlanta. Mr. Gentry's headquarters will be in that city, and he was appointed to succeed Mr. Charles H. Wilson, who has resigned to accept the general superintendency of the American Telephone and Telegraph Company, with headquarters in New York city.

Mr. B. L. McClain, who for 17 years has been actively connected with the service of the Chicago & Alton Railway Company, the greater portion of the time as general eastern passenger agent in New York city, has recently accepted the position of general agent of the passenger department with headquarters at Kansas City. This is one of the most important offices of the company, and Mr. McClain is receiving the congratulations of his friends upon his increased responsibilities. Mr. William J. Bogert will have charge of the eastern territory of the company hereafter as general eastern agent. His headquarters will be, as heretofore, at 261 Broadway, New York city.

New York Electrical Society.

Dr. Louis Bell addressed a large and enthusiastic audience at the 211th meeting of the New York Electrical Society, held in the building of the New York Gas and Electric Light, Heat and Power Company, at Elm and Duane streets, New York city, on the evening of January 30. Dr. Bell's subject was "Electric Illumination at the Beginning of the Twentieth Century." He covered the subject in an extremely comprehensive and satisfactory manner from its inception to the present date, illustrating his remarks by practical demonstrations of the various types of electric lamps, both arc and incandescent, which have made the art what it is to-day.

Several of the exhibits were new to the audience, and presented features of considerable novelty, the contrast between the first commercial arc lamp constructed by Jablochkoff and the Nernst lamp being especially notable. The construction of the Jablochkoff lamp is such that the carbon when first ignited sends out a small shower of lurid orange-colored sparks. This is due to the strip of kaolin which runs down the side of the carbon. Dr. Bell's theory regarding the refraction of light in interiors was that light from above is always the most effective, and the best refracting surface is white; then, in turn, come light yellow, red, and light blue. The greens are bad, and dark green almost as bad as black. Imitation of moonlight and sunlight was produced greatly to the delight of the audience, and Dr. Bell remarked, regarding the moonlight, that it was probably very satisfactory to lovers. The lecturer closed his remarks with a tribute to the glowworm which still has in concealment its luminous secret, and said: "To wrest that secret from the glowworm, in my opinion, will fall to the future of a chemist, not an electrician."

The president of the society moved votes of thanks to Dr. Bell, and to the officers of the Edison company for their courtesy in extending the use of the building. After the meeting was declared adjourned, it was announced that the company would be glad to have the guests of the society inspect the company's engine and dynamo room, and a very pleasant collation was served, the meeting altogether being one of the most successful the society has ever held.

The 212th meeting of the society will be held at the College of the City of New York, Twenty-third street and Lexington avenue, on Thursday, February 14, at 8 P. M. Mr. Kempster B. Miller will address the society on "Modern Telephone Engineering." The lecture will be illustrated by lantern slides.

Electric Fans in the Export Trade.

By Arthur Stanley Riggs.

In order to determine exactly the status of the electric fan in the ever increasing export business of the United States it has become necessary to make a careful and at the same time an impersonal canvass of the various manufacturers and exporters to obtain the facts required. This was done and the result, so far from showing any very heavy trade in the fans, revealed a condition which very few people outside of the immediate manufacturing or exporting electrical lines appreciate.

It would be obviously unfair to make any positive statements and give authoritative figures regarding a trade which is still in an undeveloped stage. Beginning with the exporters in order to ascertain as nearly as possible the aggregate outgo, several of the most prominent merchants in the lower end of New York were visited; their opinions are valuable inasmuch as they show the apparent apathy of otherwise energetic American firms.

In almost every instance the inquiries developed the fact that where there seems to be the most exceptional opening and the greatest need for electric fans there is little or no demand for them. On the other hand, where competition might be most confidently expected—that is, in countries like Germany, where electrical and mechanical development has reached a state of perfection equal to our own, and where every facility for the manufacture of fans and kindred apparatus is already at hand—there seems to be no desire on the part of the manufacturers to enter the business even in a small way. In the South and Central American countries situated near the equator, and where one might reasonably suppose that fans would be an almost inestimable blessing on account of the heat, there is not only no demand, but no competition. This may partially be explained by stating that most of the smaller South and Central American republics lack the requisite power for successfully operating any machinery other than the lighting or telephone plants for which that machinery was designed. This is not the case, however, in cities like Valparaiso and Lima as there is plenty of power and both capital and resources for the development of all the energy that may be needed as the countries develop in civilization and manufacturing. What seems a plausible theory to explain this curious condition of affairs (that there is no demand for fans) is that the natives, being accustomed from birth to the extreme heat and other climatic conditions which so frequently kill off Americans or other foreigners from cool countries by fever and other diseases, feel the heat but little and, being naturally thin-blooded, are to some extent immune, needing no artificially produced cooling draughts of air.

In Japan a totally different state of affairs confronts the exporter. Noted for its industry, progressiveness, indomitable energy and the aggressive civilization for which the "America of the Far East" is already celebrated, practically no finished American electrical apparatus is bought excepting only what is called for by the government. Buyers in Japan have two standards by which they purchase goods, namely, appearance and price, quality not being considered in the vast majority of cases. Incandescent lamps are made in Japan, but they are so cheap and so poorly constructed that it would be almost impossible for an American manufacturer to give them away. It is practically the same with everything else. Japanese workmen can be employed at such a low figure, their work is done so understandingly, it costs them so little to live, and they are so energetic, that for the most part apparatus can be made in Japan from raw imported materials more cheaply than a poor quality of goods could be imported in a finished condition from the United States. The native workmen are constructing fan motors, the fans themselves and apparatus of a similar nature and selling them all through the islands, while the American manufacturer who attempts to turn out a machine which will work and sell for as little money would be put to considerable loss, as he is handicapped by the high prices paid to his workmen, his freight bills, packing charges, and numerous other things which react to the advantage of the Japanese manufacturer.

Some of the few fans which are used in the Pan-American countries come from the Continent and the United Kingdom, being mostly of French, Austrian and British manufacture, and while there are more foreign fans and possibly more foreign firms engaged in that business represented in those countries, the United States has such advantages and facilities that if the trade can be influenced to the point of making a determined effort American fans will slowly and surely displace those of any other nation.

Electrical manufacturers in Germany have every facility and means at their disposal for the economical production of every imaginable sort of electrical machinery and are as well equipped to turn out such machinery rapidly and satisfactorily as any similar body of manufacturers in the world. That there should be no demand in such a country seems unbelievable, for the climate is of such a nature that the temperature varies almost as much as it does in the United States and fans throughout almost all the lower German states would prove very acceptable adjuncts to office and house comfort and convenience during the warm weather. None of the manufacturers or exporters interviewed could give any plausible reason why the German manufacturers have not attempted to compete in this branch of trade and no explanation seems to be obtainable.

A large house, which for many years has done a very extensive business with South American countries, was asked about its export fan trade and the buyer replied with a twinkle in his eye: "In twelve years we have sold just one fan—a ten-dollar toy at that. That one went to Lima. The only inquiries that we have had in the past ten years for fans of any sort were from a couple of young fellows on two of our steamers. I think they were mates. They said it got so hot down around Guayaquil that they couldn't sleep and couldn't stay in their cabins at all. What they wanted were a couple of cheap battery fans about five or ten dollars apiece, and when I told them that they couldn't get a fan for less than twenty-five dollars that was good for anything they faded away like the dew in the morning. Poor chaps! They didn't know any better, I suppose, and if they had taken one of those durned toys to sea with them it wouldn't have lasted outside of Sandy Hook! If they had taken it down to Guayaquil before attempting to operate it it wouldn't have had the chance of a snowball on the Fourth of July."

Upon making further inquiries of both manufacturers and exporters, the facts developed were very contradictory. In some instances manufacturers refused to talk, saying that they did not wish to

give any information whatsoever to their competitors, as such information would enable the latter to get a line on their trade. In other instances the exporters' statements were in contradistinction to those made by similar houses in previous conversations. A general consensus of the opinions of the most important houses seems to be that the trade is actually being done to some considerable extent, denials and contradictions to the contrary notwithstanding. One house stated that in the South American countries the Argentine Republic was the best customer, and that of all the fans it shipped the heaviest trade was in Buenos Aires.

"It is a fact, however," said the buyer of that house, "that we have never done the trade in electric fans in recent years that we did some time ago. There was one year that I remember when we sold a very large number of these fans, and I think that every store in Buenos Aires must have had one. Since that time the people with whom we did business have dissolved partnership, and the partner who was friendly to us left the firm, so that since then we have had no business with those people at all. I should say that the fan trade is best in South America, taken as a whole. As for your question regarding fans of foreign makes competing with ours, that is all nonsense; they do not do any such thing. There may possibly be a few British and French fans used, but they are inferior in quality to ours, less satisfactory in operation, and are not generally used by people who have any mechanical knowledge for that reason. Business now has reached the point where you have to hustle for it, whether at home or abroad, and we have our local agents working on the subject all the time, but for some reason they do not seem to be able to do much business along this line."

Another large export firm, whose business is not confined to any particular country, said: "Australia is the best market for electric fans. We have a branch house in Sydney, a corps of traveling men, and we keep the market there stirred up all the time. After Australia would come South Africa. The trade in South Africa is good mainly because the country is new and the electrical installations there afford more power than is actually required for traction or lighting purposes. We do not think that the British electrical manufacturers need be considered formidable competitors. The French we consider somewhat better, but then they are not particularly dangerous, and there is no competition at all from Germany. We sell some fans to German houses, and it seems to us that the situation may be summed up something like this: Electricity is as yet in its infancy, the average man does not know very much about it, and in almost every country except the United States, England and Germany, electrical power and electrical installations are in a comparatively crude and inefficient state. As fast as the local engineers learn the value and cheapness of electrical methods there is no doubt in our minds at all but that the electric fan will come to be regarded as a positive necessity. We used to sell a great many of the Lundell fans, but lately we have not shipped one, and just what the reason is we do not know. It is safe to predict, however, that in South America, as fast as plants are installed which have a greater capacity than is required at the time, and just so surely as electrical machinery is sent to those countries, the fans and fan motors will follow."

A third exporter said that he had never done any business in fans, and declined to talk about the matter at all, but a nearby competitor said that the former had recently received an order for several thousand dollars worth to a South American port.

Under the circumstances, and in the face of such contradictory statements, it may be safely assumed that there is a considerable trade being done at the present time in fans, and the very fact that the manufacturers and exporters are united in refusing to give any definite information may be regarded as proof positive that not only is business comparatively active in such lines, but that the field is promising and the demands constantly increasing.

So far from desiring to advertise their goods by stating the countries to which they go, and the aggregate amounts of the various shipments, the exporters seem to fear that even a chance remark unintentionally made will give some competitor a chance to hurry an agent to the country mentioned and steal away the trade before the former has time even to think about it. That there is also competition from foreign firms in the United Kingdom and on the Continent is hardly to be doubted, because, were it not so, it would hardly have been mentioned. Just how great that competition is, and how severe it is likely to become, no one on this side of the water can tell. But if the United States is to continue her advance over all other countries in the value of her export trade, the houses which ship electrical apparatus and electric fans to foreign countries must arouse from their state of semi-apathy, and make determined efforts for two reasons. In the first place, England, having viewed with alarm our recent encroachments on her time-honored rights in the matter of steel contracts in the Soudan, and in various other countries and places too numerous to mention, will make a bitter fight for all the trade she can possibly get. There are plenty of American engineers in the employ of British firms who will strain every nerve to the utmost to serve their employers. In the second place, there is between all countries which are practically tributary to Great Britain a very decided preference for British manufactures when they can be as cheaply bought or do as satisfactory work. In order to get American goods into such countries and obtain a firm foothold, American manufacturers must be able to demonstrate in the most practical manner that their goods have advantages unapproached by those of other manufacturers. In the same manner, countries in which the Romance languages are spoken are bound to one another by the same consanguinity that exists between Britain and her colonies, so that the same proposition applies in the latter as in the former case. The field is wide and open to all comers, and the proposition in general may be stated that no unfair advantages have so far been taken by any of the competing countries. With our natural advantages, being nearer the countries where these fans are most in demand than is England, we have every right to expect that by energy, square dealing and honest fulfillment of business promises, we will eventually secure the major portion of trade, and it therefore only remains for the exporters as earnestly to fulfill their part as for the manufacturer to turn out a perfect and finished machine.

The Institute Presidency.

For a number of years it has been a custom in the American Institute of Electrical Engineers to reelect presidents of that body for one or more terms, and the renomination of a president upon the expiration of his first term has lately become a matter of form. Among those who have been opposed on principle to this custom is Mr. Carl Hering, the present president of the Institute. He requests the ELECTRICAL REVIEW to state that he will not consider a renomination. He believes that the office should be held by a different incumbent each year, and wishes to inform his friends that in the forthcoming balloting they will best please him by voting for an eligible candidate.

Lord Kelvin in a Peculiar Position.

[*From the Telegraph Age.*]

A few hundred yards of one and one-quarter-inch aluminum wire were put up by Lord Kelvin on a Scotch estate somewhat over a year ago, and on this line he is watching the effects of weather.

A NEW PAGE-PRINTING TELEGRAPH—II.

BY WILLIAM B. VANSIZE.

CURVES OF VIBRATION OF REED.

I have here a diagram, Fig. 2, showing the action of a reed when free to vibrate without limiting stops, as compared with the action of the same reed operating under the constraint imparted by the tapering springs, called resilient limiting stops. The figures were obtained by

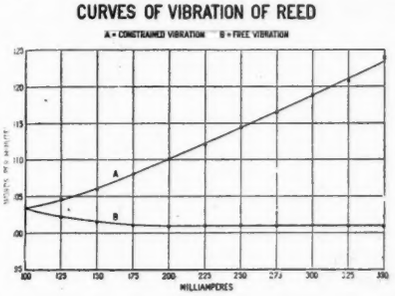


FIG. 2.—A NEW PAGE-PRINTING TELEGRAPH.

varying the amount of current flowing through the reed magnet coils and then measuring the amount of tape fed through the perforator under control of the reed. The tape is fed forward one step for each vibration of the reed, and its extent therefore gives an exact record of the rate of vibration per minute. The receiving vibrator and other instruments were set to transmit and record at the rate of 112 words per minute, and the current in the reed magnet was then varied with the following result:

Current in Milliamperes.	Tape fed per minute Feet.	Inches.
350	24	0
325	23	4⅜
300	23	0
275	22	6¾
250	22	1¾
225	21	8⅛
200	21	4
175	20	11
150	20	6
125	20	3
100	20	⅛

The action of the resilient limiting stops began at 100 milliamperes. The vibration with this amount of current was very slight. About 230 milliamperes were used for the 112-word rate.

The following table shows the effect of removing the resilient limiting stops, all other conditions being as before.

Current in Milliamperes.	Tape fed per minute. Feet.	Inches.
350	19	6½
325	19	6⅛
300	19	7
275	19	6¼
250	19	6¾
225	19	6⅛
200	19	6
175	19	7
150	19	8
125	19	9⅛
100	20	⅛

The reed did not vibrate reliably under 100 milliamperes, and even with that current it was feeble. The vibration did not become fairly strong until 125 milliamperes was reached. The figures and the curves indicate that the speed increases with decrease of current below 150 milliamperes. This was possibly due to the electro-magnet damping effect of the iron armature vibrating in the magnetic field. Actual trial has shown that this effect is too feeble and unstable to be used for governing the rate of the reed by possible variation in the current. A more positive and reliable result was required, and it was supplied by the resilient limiting stops. It will also be seen by the diagram that above 150 milliamperes the rate of vibration of the reed is uniform irrespective of the amount of current when the reed is not constrained by the resilient limiting stops. This is indicated in the straight horizontal portion of the curve B. Curve A shows the effect of the resilient limiting stops in causing an almost uniform acceleration of the speed of the reed in accordance with the increase of current. With respect to the curve A the variation in words per minute between extreme points is from 103 words with 100 milliamperes to 123 words with 350 milliamperes, and with respect to the curve B the variation in words per minute is from 103 words at 100 milliamperes to 101 words at 350 milliamperes, a perceptible decrease in the word rate, with an increase of three and one-half times in the strength of current.

The forms of limiting stops experimented with and heretofore referred to

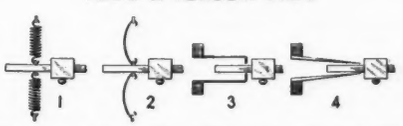


FIG. 3.—A NEW PAGE-PRINTING TELEGRAPH.

are shown upon the diagram "forms of resilient stops," Fig. 3. Nos. 1 and 3 are practically ineffective for the purpose intended; No. 2 is susceptible of some beneficial use, while No. 4 is a practically successful arrangement, and the one to be preferred.

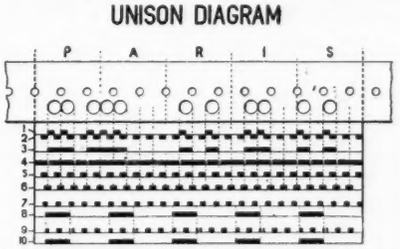


FIG. 4.—A NEW PAGE-PRINTING TELEGRAPH.

THE UNISON DIAGRAM.

I have here a "unison diagram," Fig. 4, to illustrate the relative position of the current impulses in securing unison. There is shown a section of receiving tape in which appears the word "Paris," the division between the letters being marked with a dotted line. Below the line of the tape is shown the corresponding conditions of current in the local and main-line circuits; when in unison, and again when out of unison. In line 1 there is shown the current impulses in the punching magnet circuit effective to produce the perforations shown on the section of tape; line 2 shows the current impulses in the local spacing current; at line 3 are shown the main line impulses due to the operation of the automatic transmitter effective to produce the perforation in the tape represented; at 4 is shown the operation of the armature of the governing relay, the unshaded divisions representing the "armature transit time," and the relative position of the armature transit with respect to the impulses in the main and local circuits; at line 5 are shown the impulses in the motor-magnet circuit which operate to drive the reed; these impulses are shown as in unison with the main line and local-circuit impulses. In line 6 are shown the same motor-magnet circuit impulses out of step or out of unison. The continuous operation of the unison device is best illustrated in the actual record taken upon a chemically prepared paper tape with a pair of iron pens, one in the local circuit and one in the main circuit; the pens were arranged side by side; line 7 shows the record of impulses in the motor-magnet circuit; line 8 shows the main-line impulses, the action of the armature of the governing relay having been suppressed. In lines 9 and 10 the same means are employed to render graphic the impulses in the two circuits, and the operation of the transit of the armature bar 26 of the governing relay is also apparent in clipping the local-circuit impulses, and thus curbing their motive power effect on the reed. There is thus established a continuous "dynamic balance" between the tendency of the reed to accelerate its speed and the tendency of the main-line signals to retard its speed. The shape of the punch for perforating the receiving tape is quite important. A large number of forms were tried. The diagram "Forms of Punch" (Fig. 5) shows some of the leading shapes. No. 5 is much the best.

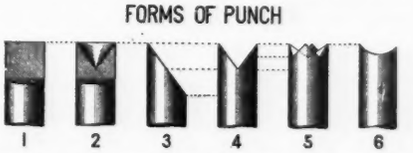


FIG. 5.—A NEW PAGE-PRINTING TELEGRAPH.

Official figures for the calendar export year just closed show it to be a record period, our manufactured exports to foreign countries having reached a total of $1,478,050,854; or, in other words, nearly $3,000,000 in excess of the total for 1899, which was the previous high-water mark. In no month during the past year did the aggregate value of the exports fall below $100,000,000, while the total for December—$145,994,606—made a new record for that or for any one month. Imports for the United States showed a total value of $829,052,116, or $648,998,738 less than the valuation of our exports, this being an increase of $172,498,177 over the record of last year. The total foreign trade of the United States in the 12 months was $2,307,102,970, exceeding by nearly $240,000,000 the trade of 1899.

A charter has been applied for by the Lookout Mountain, Tenn., Rapid Transit Road, which will soon be incorporated with a capital stock of $250,000.

Export Notes

Newspaper reports state that the prospect for an active demand at an early date for electrical material in Cuba is unusually promising.

Some heavy contracts for American electrical machinery have recently been secured from Brussels, Belgium, while considerable metal-working machinery has gone to Antwerp.

An export transaction in steel, which called for 17,000 tons of rails and 2,000 tons of fastenings, was closed in Chicago during the week of December 28, for shipment to Australia.

Inquiries from Buenos Aires, Argentina, to local export houses state that preparations are being made in that city for the erection of various industrial plants, which will require large quantities of finished products.

A project is said to be on foot in Brazil for the construction of an electric railroad from Piracicaba to Villa Americana in the old American colony of Santa Barbara, in the state of Sao Paulo. The estimated cost of the line is $2,500,000.

An order for $60,000 worth of electrical machinery was received on December 22 last from Bremen, Germany. The material in question is to be used in a South American electric railway, for which a German engineering company made the lowest bid.

It was considerable of a surprise to American Engineering firms to learn that Messrs. Ganz & Company, of Budapest, Austro-Hungary, were the lowest bidders for equipping the Metropolitan District Underground Railway, of London, England, with electrical apparatus, that company's bid being $1,500,000.

The largest export order for wire ever received in the state of Connecticut has been completed, and called for a million pounds of trolley wire for a road in India. The entire shipment weighed 1,500,000 pounds, of hard-drawn copper, and it required 27 cars and two engines to transport the shipment. The reels on which the wire was wound were built of 80,000 feet of lumber.

American apparatus is finding favor in the Hawaiian Islands, reports from Hilo stating that the Hilo Electric Company is installing a 250-kilowatt Westinghouse generator direct-connected to a McIntosh & Seymour engine. Further improvements are soon to be installed by the company, and the apparatus needed will be purchased in this country, the company's agency being in San Francisco.

During the second week in December, exports from New York to the British East Indies reached a total of $120,000 for electric railroad material, $10,000 for manufactured steel and $46,000 for lubricating oil. During the same week, the steamer Richmond Castle took $13,000 worth of electrical material and $10,000 worth of railroad supplies to Hong Kong, China.

A large quantity of electrical material for the Australian market has recently been ordered in New York city, the aggregate of the purchase reaching a possible total of $22,000. It will be shipped to Melbourne by the same steamer which, on her last sailing, took $17,000 worth of hardware, $35,000 worth of electrical apparatus and $16,000 worth of manufactured iron to the same port.

Shipments of electrical merchandise to Manila, P. I., continue to grow steadily, the last shipment being valued at $13,000. Consular reports state that agents for American goods are becoming more and more numerous, and the chief difficulty in obtaining the Philippine trade is the mistake made by American firms in sending out men unacquainted with the Spanish language and customs, or methods of trading in these islands.

Inquiries for railway material for Mexico are said to be coming in already. This is considered unusually early in the year for such applications, and merchants in New York are said to be sending quotations to private railroads in the "Sister Republic" for a considerable amount of electrical railroad material. More than $15,000 worth of electrical railway material has recently been shipped to Mexico by the General Electric Company.

A New York engineering firm is said to be figuring for its London agent on electrical material for export to the Indian market. The value of the invoice is expected to reach about $28,000 for supplies, while the machinery needed will reach about $56,000. The steamer Caspian recently took to Calcutta $40,000 worth of manufactured steel, $15,000 worth of electrical and other machinery, and $11,400 worth of trolley poles.

As an example of the reason why American firms have so little difficulty in competing with their British neighbors in export orders the following incident may be cited, which is self-explanatory: The Post Commissioners of Calcutta, India, recently placed orders for locomotives in the United States. The lowest English tender quoted was $7,720 for each engine, and nine months were required for their delivery. American bids quoted $6,300 apiece, and guaranteed delivery in six months. The American tender was accepted subject to governmental approval.

Kertch, Russia, is said to be figuring on an electric railway. The province in which Kertch is situated, Yenikalae, is said to be disposed to award the concession for the road to some foreign engineering firm. The town has a population of 50,000 inhabitants, which is said to be rapidly increasing, and there seems to be a steady growth in its prosperity and in the chances for good investment, on account of the different metallurgical factories and the exploitation of mines in the vicinity. At the present time a railway is being constructed between Kertch and Theoosie. Full particulars may be obtained by applying to the Avoz-Don Bank, Kertch, Russia.

Official reports of British exports from all ports in the United Kingdom to foreign countries for electrical apparatus and material, including telegraph and telephone wire and materials, but excluding electrical instruments and machines, which are not separately specified, reached the following totals for the week of January 9 to January 15:

To Africa (all ports)	£1,020
" Australasia	5,767
" Ceylon	73
" China	155
" Denmark	187
" Germany (telegraph material only)	400
" Gibraltar	14
" Holland	100
" Indian Ports	1,012
" Madeira (telegraph material only)	490 305
" Portugal	9,720
" Russia	2,560
" Siam	225
	£511,538

The total of all such exports reaches £511,557 as against £14,032 for the corresponding week of the previous year.

A newspaper which devotes considerable space to American export trade recently stated that the extensive field found by American manufacturers in the United Kingdom is not at all remarkable, on account of the rapid increase in capital there during the last year. In electrical undertakings the increase has amounted to £106,000,000, which is exclusive of the government telephone and telegraph, the greatest increase having been in connection with tramways, supply and manufacturing plants. In five years the total capital involved has been doubled, while the money involved in electrical manufacturing has increased from £6,500,000 to £21,708,180, of which increase £5,000,000 are credited to the year 1900. This rapid advance is explained by the extensive application of electricity to lighting, power and traction.

Death of Henry C. Davis.

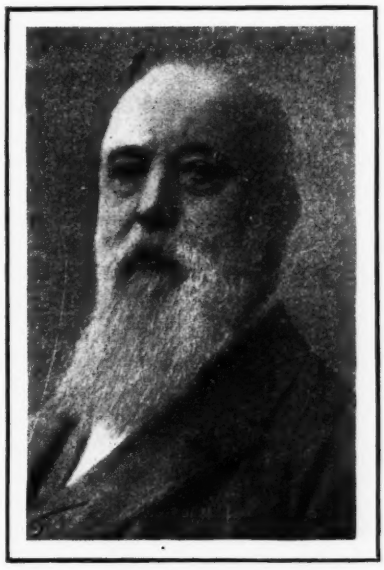
Henry C. Davis, a well-known Philadelphian, and until recently actively connected with the electrical industry, died at his home in Philadelphia on January 30, after a year's illness. He was born in Philadelphia 62 years ago, and his boyhood was spent on a farm in Cheltenham, Montgomery County, Pa. He was a grandson of Lucretia Mott, the famous abolitionist. During Mr. Davis's youth the celebrated "underground railway" was in operation, and his father's house, as well as many other Quaker homes in the neighborhood, was one of the way stations for fugitive slaves on their way to Canada and freedom. Mr. Davis was himself a strong abolitionist, and has always been known as a friend of the negro race. He was a friend of Booker T. Washington, the southern colored leader, whom he frequently entertained, and was a trustee and liberal patron of the Tuskegee Institute, of which Mr. Washington is president.

After leaving school, Mr. Davis entered his uncle's wool house in Philadelphia as a clerk. During the Civil War he conducted a wholesale woolen business in partnership with the late Colonel Charles H. Banes and George W. Fiss. He subsequently retired from this business to look after his railroad and mining interests and the estate of his father. For 10 years he lived abroad with his family, residing in England and France, subsequently returning to New York to live. Three years ago he returned to Philadelphia, where he had since made his home. Mr. Davis was president of the State Line & Sullivan Railway Company, and was largely interested in coal mining operations. He had been a member of the Union League Club of Philadelphia since 1865, and was also a member of the Lotos, Lawyers, Transportation and Engineers' clubs of New York city. In the early days of the New York Electric Club, Mr. Davis took a great interest in its efforts and at one time served as its president. During the pioneer commercial development of the electrical industry he was prominently connected with the Sawyer-Man Electric Company, and always maintained his interest in electrical matters. Mr. Davis is survived by his widow, two daughters, and a son, Charles Henry Davis, a well-known electrical engineer of New York and Boston.

OBITUARY.

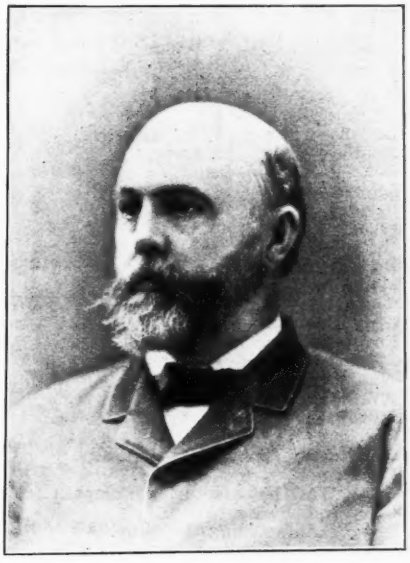
J. H. McGrew, manager of the Kester Electric Manufacturing Company, of Chicago, died at his home in La Grange, Ill., on January 27. He was 43 years of age, and leaves a widow and one daughter.

Ellis Milne Jackson, superintendent of construction and maintenance for the Central Union Telephone Company, of



ZÉNOBE THÉOPHILE GRAMME.

Chicago, died at San Rafael, Cal., on January 23. He had been ill with Bright's disease for some time, and went to California in the hope of regaining his health. He was 38 years of age, and had been



HENRY C. DAVIS.

connected for many years with various Bell telephone companies.

Joseph Gillette Noyes, secretary and treasurer of the National Electrical Manufacturing Company, of Milford, Ct., died recently at his home in that town. For some years he was manager of the electrical department of the New Haven Clock Company, in New York city. After the formation of the National Electrical Manufacturing Company he succeeded to the position of secretary and treasurer, which he held up to the time of his death.

Death of M. Gramme.

On Sunday, January 20, M. Zénobe Théophile Gramme died at his country residence at Bois Colombes, near Paris. M. Gramme was born in Belgium in 1826, and brought up to the trade of a carpenter. His early predilections were for scientific subjects and machinery, and he attended a course of lectures at Liège, Belgium. This, however, had little practical influence upon his career, and when he was upward of 30 years of age he was still working in Paris as a carpenter and stair maker.

Working as a pattern maker in the Alliance factory, in Paris, and later in the workshops of Ruhmkorff, he learned the details of electrical construction and insulation as they were then known, and became still more deeply interested in the mysterious work upon which he was engaged. It was during the sixties that Professor Pacinotti, then a student in the University of Pisa, where he is still professor, described the toothed-ring armature magneto-electric machine which has since been recognized to have been the forerunner of the modern dynamo. This really brilliant invention met with no success and was never developed, and it remained for Gramme, in 1870, to devise the uniformly wound ring armature machine, with which his name has ever since been associated.

From the very beginning of the success of this apparatus, Gramme sought publicity in international expositions. The dynamo was shown at the Centennial Exposition, in Philadelphia, in 1876, and attracted the deepest attention from electricians in this country. In 1878 the electric lighting of the Paris Exposition by the Jablochkoff candle was really made possible by the cooperation of Gramme and his associates.

M. Gramme was never a learned man in the sense that we employ that term of engineers to-day. His knowledge was instinctive and almost prophetic. He could not calculate parts or sizes for his machines, but he felt that certain proportions were right, and was undoubtedly a remarkable intuitive engineer. In March, 1897, he was made a Knight Commander of the Order of Leopold, and on the occasion a banquet in his honor was given in Brussels. A gold medal recording the event was struck to commemorate the signal services of the then veteran inventor to science and industry. Besides the decorations above mentioned, he was an officer of the Legion of Honor, and Chevalier of the Iron Crown, of Austria, and a member of many engineering societies.

Philadelphia's First Automobile Show.

Some time ago the members of the Pennsylvania Automobile Club determined to hold a show and exhibit in Philadelphia, and it was finally decided to hold the affair in the Second Regiment Armory, at Broad and Diamond streets, from February 4 to February 9, inclusive.

From a large festoon in the centre of the roof of the drill hall lines of many colored flags and countless electric lights were strung to the sides of the building and the ordinarily dark interior was transformed into a very pretty and gay colored auditorium. The great stone building was filled with more than 300 vehicles of different descriptions, ranging from small automobile bicycles to heavy vans and elegant private equipages for pleasure purposes.

More than 60 exhibitors were represented at the show, a list of which is appended. Among them are the representative manufacturers of the country. The main floor of the armory was laid out in a circle, in whose centre were 55 exhibition booths divided by three aisles running parallel to Broad street, the whole being surrounded by an 18-foot speeding track. At one corner of the building a bridge was built over the track to enable the visitors to pass into the exhibition booths inside the circle without any difficulty or danger of interfering with the vehicles which were being exhibited in motion. Along the sides of the building were 30 stalls, ranging in size from 60 to 276 square feet in area. The usual features of such exhibitions, which are familiar to New Yorkers from the shows which were held at Madison Square Garden and at the Grand Central Palace last year, were present and interested the Philadelphians greatly.

Features of the show were the skillful handling and speeding of machines around the track, much of this being done by ladies who are members of the Woman's Automobile Club. They drove vehicles ranging in size from tricycles to tally-hos with ease and precision, speeding, stopping, backing and making dizzy turns without collisions or risk of accident. In the booths were presented not only the finished machines so familiar to every one, but all the accessories and parts, while the attendants in charge explained every particular to a curious but intelligent crowd. The display of fixtures and accoutrements was fully as complete as the automobiles themselves.

In the events of the show may be mentioned a one-mile pursuit race for steam carriages, brake contest for electric carriages and an obstacle race for gasolene machines, all of which took place on Monday night. On Tuesday evening coat and vest, obstacle and one-mile pursuit contests were held for the three types of vehicles mentioned above, and on Wednesday evening there were coasting, pursuit and two brake contests. The events of Thursday evening were similar to those on Tuesday, while on Friday evening a coat and vest contest for electric machines was held and obstacle and coasting events scheduled for steam and gasolene machines. Winners in all classes and in all events were scheduled to meet on Saturday evening, at eight o'clock, for the final prizes in brake, obstacle, coat and vest and one-mile pursuit races. The prizes given were handsome silver cups for each final. The method of holding the coasting contest was somewhat unique inasmuch as the rules announced that "carriages will attain an even speed and at a given signal shut off power; carriage coasting greatest distance winning."

The members of the Automobile Club say that the show has been successful in every respect despite the friction which was induced between the Cycle Board of Trade and the Automobile Club by the former, and it is believed that every manufacturer who was represented in the show did business that amply repaid him for his exhibits. The list of the exhibitors follows:

Locomobile Company of America.
Mobile Company of America.
Electric Vehicle Company.
John Wanamaker.
Orient.
Foster.
Maurice Loeb.
De-Dion Bouton.
Marlboro.
Century.
Gray & Davis.
Bevin Bell Company.
Gleason-Peters Pump Company.
Wharton & Wright.
Winton.
Steam Vehicle Company of America.
Overman.
Manufacturers' Supplies Company.
Fanning Electric Company.
R. C. Wall Manufacturing Company.
Chas. L. Schwarz.
Rose Manufacturing Company.
Liberty Bell Company.
Diamond Rubber Company.
Consolidated Tire Company.
Rothchild & Company.
Motor Vehicle Power Company.
Philadelphia Gas and Gasolene Engine Company.
Pennsylvania Rubber Company.
Hinchman & Hawkins.
Skene American Automobile Company.
National Electric Automobile Company.
H. P. Feister—representing a gasolene and a steam vehicle.
Matsinger Sparker.
Thorncroft Steam Wagon Company.
Janney & Steinmetz.
N. Y. Belting and Packing Company.
Palmer Motor Company.
Fulton & Walker Company.
Diamond Electric Company.
Davie & Company—Goodyear Solid Rubber Tires.
Delaware Rubber Company.
William F. Rudolph.
Dow Portable Electric Assistant Company.
Dixon Crucible Company.
Union Motor Truck Company.
Woods Motor Vehicle Company.
Keyser & Rogers.
Hartford Rubber Works.
Boisselot Automobile Company.
Jensen & Grossman.
Columbia Lubricants.
Grout Brothers Company.
A. L. Smith & Company.
R. E. Dietz Company.
Standard Motor Vehicle Company.
American Automobile.
The Hub.
Horseless Age.
The Automobile.
Automobile Trade Journal.
American Inventor.
H. B. Hart.
Blaylock & Blinn.
Diebler-Eppler Manufacturing Company.
Knox Automobile Company.
Howard Steam Wagon Company.
J. A. Fowler.

Wall Street and the Electrical Stock Market.

The stock market closed on Friday of this week, business being adjourned on Saturday on account of Queen Victoria's funeral.

On the New York Stock Exchange, General Electric closed the week at 190½ bid and 191 asked, indicating a gain of 2½ points. Metropolitan Street Railway, of New York, closed at 163 bid and 163½ asked, showing a gain of ½ point. Brooklyn Rapid Transit closed at 77 bid and 77¼ asked, showing a loss of ⅞ point. Third Avenue Railroad closed the week at 120 bid and 121 asked, indicating no change in either price. Manhattan Railway, of New York, closed at 117⅛ bid and 117½ asked, indicating a gain of ⅞ point.

On the Boston exchange, American Telephone and Telegraph closed at 163 bid and 165 asked, showing a gain of 2 points. Erie Telephone closed at 58½ bid and 59 asked, indicating a gain of ½ point. New England Telephone was not quoted.

On the Philadelphia exchange, Electric Storage Battery was not quoted. Electric Company of America closed at 8 bid and 8½ asked, showing a loss of ⅛ point for the week. Union Traction closed at 35¾ bid and 35⅞ asked, indicating a gain of 2 points.

On the curb, or outside market, in New York, Electric Vehicle closed the week at 16 bid and 18 asked, showing a gain of 1 point. Electric Boat closed at 27 bid and 29 asked, indicating a loss of 2 points. Consolidated Equipment closed at 10¼ bid and 10¾ asked, showing a loss of 1 point for the week.

Wall street, February 1.

Slow-Speed Motors for Machine-Driving.

In the illustrations herewith are shown a form of motor recently produced by the Crocker-Wheeler Company, and intended for belting or gearing to various machinery, together with two examples of machines driven in this way.

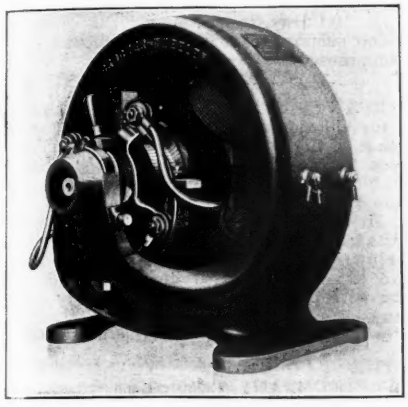


FIG. 1.—SLOW-SPEED MOTOR FOR MACHINE-DRIVING.

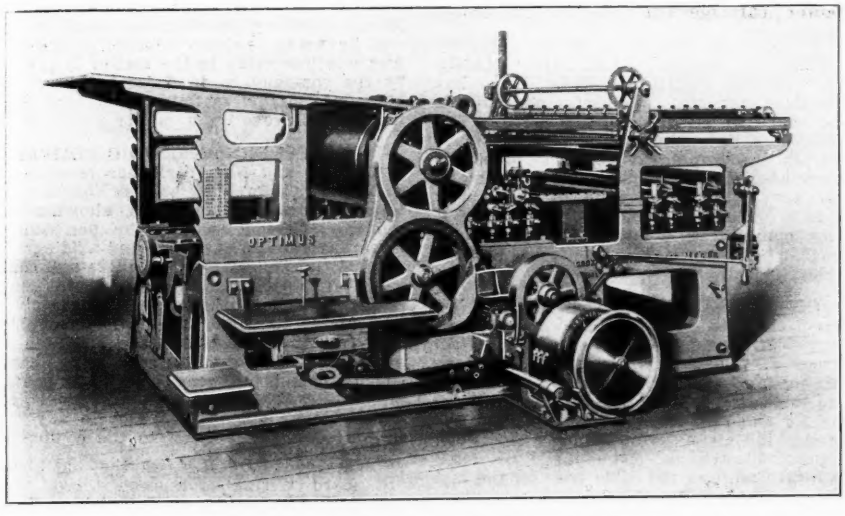


FIG. 2.—SLOW-SPEED MOTOR GEARED TO PRINTING-PRESS.

The magnet frame is a single casting carrying supports for the armature bearings with it. One of the bearings is made separate so that its removal will allow the armature to slide endwise out from the frame. As will be seen by Fig. 1, the seat for the bearing is bored out at the same time that the field is bored, thus insuring the alignment of the bearing and of the shaft of the motor. Feet projecting from the frame support the motor on a cast-iron base, the whole design being exceedingly simple and solid.

The pole-pieces are of circular cross-section, of wrought-iron, cast-welded into the magnet frame. The shoes or pole faces are removable and are made of laminated steel, serving the double purpose of holding the field coils in place and properly distributing the magnetic flux emanating from the pole. Much increased efficiency is secured by the lamination of these pole shoes, which secures good commutation and an absence of eddy currents tending to produce wasteful heating.

The armature shaft is turned up from bar steel and runs in brass journal boxes fitted with oil rings for automatic lubrication. The lips of the journal bearings have been carefully studied out so that it is claimed that even at the highest speeds there is no throwing of oil from these machines.

The field coils are wound on heavy spools and are made as solidly as the art allows. The armature winding is of the barrel type, using formed coils laid in open slots, cast-iron flanges overlapping and supporting the ends of the coils at the ends of the core. All of the insulation on these machines is of a substantial and heavy type. The commutator is made of hard-drawn copper bars insulated with soft mica, the bars being connected to the wires by means of copper tails riveted and sweated into the bars proper and soldered to the wires at their outer ends. By this construction it is stated that the soldered joints are kept cool at all times, while the connecting tails, being thinner in cross-section than the bars, leave between them open spaces highly useful for ventilating the head of the armature. Unusually heavy construction has been adopted for the brush holders, which carry carbon or graphite brushes. The brush tension is varied by helical springs, and the holders are so made that the motion of the brushes is always parallel to itself, thus keeping the brush always normal to the surface of the commutator.

These machines are made up in shunt, series, or compound windings, according to the work required of them, and are built in sizes of from three to nine and one-half horse-power, varying in speed from 1,200 to 850 revolutions. This type of motor has already found considerable commercial use, the illustrations on this page showing two examples of its connection. In Fig. 2 is exhibited a motor of five horse-power geared to a Babcock "Optimus" printing-press. This variety of service is particularly difficult for a motor, owing to the wide variation in the power required in a single revolution of a press cylinder, and the necessity for stopping and starting the press instantly, or of working it around inch by inch during the process of "make ready." Fig. 3 exhibits a motor of seven and one-half horse-power of this type geared to a Watson & Stillman two-plunger vertical pump for high-head service.

Norway as a Carbide Producer.

The new carbide works at Meraker, to the north of Trondhjem, are expected to produce about 2,500 tons of carbide this year, and to employ nearly 100 hands. The carbide will be shipped from Hommeloig and Trondhjem, and will form an important part of the industrial products from the north of Norway. At present only 50,000 horse-power are utilized out of an estimated possible 263,000 horse-power derivable from the water-power to the south of Trondhjem, says a British contemporary. The carbide works at Sarpsborg have now been open for 15 months, a continuance furnace being used, whilst new factories are being erected at Christiansand, Notodden and at Hardanger. Intermittent furnaces are also being erected in Norway, so that it will be possible to compare the two systems under similar economic conditions.

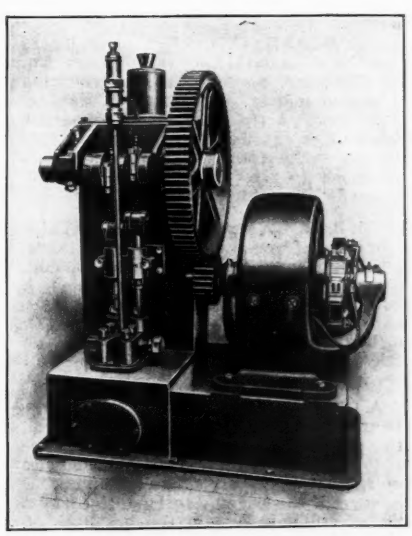


FIG. 3.—SLOW-SPEED MOTOR GEARED TO VERTICAL PUMP.

Industrial Notes

THE BOSTON ELECTRIC HEATING AND POWER COMPANY, Boston, Mass., will soon publish a handsome catalogue illustrating its new types of electric heaters as well as improvements in electric chandelier and desk fans of novel construction.

THE NORTH ELECTRIC COMPANY, manufacturer of telephones, Cleveland, Ohio, has opened an office in Chicago, at 1511 Monadnock Block. This office will be in charge of George W. Conover, and will be headquarters for the western trade of this company.

THE JOSEPH DIXON CRUCIBLE COMPANY, Jersey City, N. J., is distributing a neat blotter which bears upon its face three portraits, Washington, Lincoln, and Dixon, respectively. Below the portraits is the calendar for February, the whole being printed in red.

THE ELECTRIC APPLIANCE COMPANY, Chicago, is out with a new hotel telephone, which it claims has many points of advantage over other makes on the market. The company is sending descriptions of this instrument to dealers and contractors throughout the country.

THE SMITH & HEMENWAY COMPANY, and the UTICA DROP FORGE AND TOOL COMPANY, both of Utica and New York city, have issued their "Green Book" of hardware specialties for the current season and a very neat little diary for 1901 containing considerable general information of value.

THE ST. LOUIS AUTOMOBILE AND SUPPLY COMPANY, St. Louis, Mo., claims to be the first organized company in the United States to start an automobile supply business, having begun operations over a year ago, as the Automobile Supply Company. The company can help anyone to build anything from a motor bicycle to a wagonette.

J. G. BRILL COMPANY, Philadelphia, Pa., and London, England, is mailing upon request a handsome catalogue of its convertible cars for electric street railways. These cars were awarded a Grand Prize at the recent Exposition. The book contains much of interest to street railway men and contains handsome half-tones of the cars and accessories.

SCIENCE AND INDUSTRY, the magazine published monthly by the Colliery Engineer Company, of Scranton, Pa., contains considerable matter of interest in its current number. Articles covering numerous branches of enterprise are contained in this issue, and range from the splicing of telephone cables to rivet holes. The magazine is copiously illustrated.

MR. E. L. BROWN and Mr. H. E. McLain, both of whom were connected until lately with the Bibber-White Company, of Boston, will soon establish the firm of Brown & McLain, 41 Federal street, Boston, to act as manufacturers' agents. These gentlemen have had considerable experience in the electrical supply business and are well known in the New England territory.

IN A CIRCULAR LETTER issued by the Delaware, Lackawanna & Western Railroad to its employees, the following reference is made to the International Correspondence Schools, Scranton, Pa. "Having personal knowledge of the benefits to be derived by a course of study in any of the branches offered by this school, the good effects it is producing, and the satisfaction it is giving to railroad men on other lines, and knowing also its high standing as an educational institution, we confidently recommend it to all employees of this company who desire an improved education and a general knowledge of railroading, and urge them to avail themselves of this opportunity."

AS A RESULT of a brief interview had with Mr. C. O. Baker, of Baker & Company, relative to the situation of the platinum market, it is learned that platinum has never been so high as at the present time, this, notwithstanding the fact that the demand has never been greater. All indications, as a result of this condition, point to an early and substantial increase in the present quotations.

THE AMERICAN BLOWER COMPANY, Detroit, Mich., is sending out an attractive catalogue of its "ABC" vertical and horizontal, high-speed engines. The book contains pertinent descriptive matter and several half-tones of interest. Red ink is used for the page heads and the cover is of heavy, terra-cotta board, embossed in brick red and black. The book will be mailed upon application to the company.

THE AMERICAN BRIDGE COMPANY has closed a contract with the crown agents for the colonies of Great Britain to furnish and erect on the line of the Uganda Railway, in Africa, 27 viaducts. This will require about 6,000 tons of steel work. These viaducts consist of plate girder spans on towers; the highest tower will be 112 feet. Sir A. M. Rendel & Company, of London, England, are the engineers for the crown agents.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, New York, has issued a very neat and useful souvenir in the shape of an atlas of the world. The little book is handy in size and is said to contain geographically correct maps of every known and recognized country, state, province, or other division of the world. It is a valuable adjunct to the desk of a busy man, being so arranged as to adapt itself to either the hurried or the more leisurely method of reference.

JOSEPH MEUCHEN, 1237 Broadway, New York city, is mailing his catalogue of theatrical lamps, optical lanterns and accessories. The book is well prepared, containing much valuable information for any one interested in this type of electric lighting for stage or other display effects. It is bound in green and stamped in gold. Copious illustrations make the book interesting to all, and the cable code on the last pages makes it possible to order inexpensively from abroad or from a distance in the United States.

STEAM TURBINES, the able paper prepared and read by Mr. Francis Hodgkinson before the Engineers' Society of Western Pennsylvania, and which appeared in the ELECTRICAL REVIEW for December 26 and January 5, has been reprinted by the Westinghouse company's publishing department, with special reference to the Westinghouse - Parsons turbine. The pamphlet bears out the usual standard of excellence set by the Westinghouse company and will be sent upon application to the company at East Pittsburgh, Pa., to any engineer interested.

MR. GEORGE H. DANIELS, general passenger agent of the New York Central & Hudson River Railroad, has recently issued a neat folder of steamer sailings for February, and in connection with it a map of the world. Representatives of the Central will be on hand to meet steamers of all important lines when they come in to give information regarding railroad connections, to attend to baggage and be of general use to passengers unfamiliar with New York. The folder will be mailed to any one interested upon application to the Passenger Department.

THE AMERICAN ELECTRIC FUSE COMPANY, Chicago, Ill., states that it is manufacturing in ever increasing quantities its standard lines of fuses, fuse wires, fuse blocks, lightning arresters, connectors, paper insulators, magnet wire, etc., etc. Having made several marked improvements in its factory and storerooms this company is able to carry now a much larger stock than heretofore, and through its New York office, at 116 Nassau street, managed by Mr. W. B. McCurdy, it will supply the demands of the eastern trade with all despatch and promptness.

THE ELECTRIC STORAGE BATTERY COMPANY, of Philadelphia, manufacturer of the chloride accumulator, announces that owing to the very large increase in its business in the middle western states, it has established a branch office at St. Louis, Mo. This office has been placed in charge of Mr. R. H. Klauder, formerly of the company's Philadelphia staff, and will be located in the Wainwright Building. Mr. Klauder's extensive experience, gained during his connection with the Electric Storage Battery Company, has made him thoroughly familiar with up-to-date storage battery practice.

THE COLUMBIA INCANDESCENT LAMP COMPANY, 1910 Olive street, St. Louis, Mo., is sending out its four months' calendar for the current year. The calendar is printed on a handsomely lithographed card, and shows 10 samples of the different types of Columbia incandescent lamp. The calendar itself runs from February to May, inclusive. The Columbia lamps are too well known to need any detailed description. Any one interested in the matter is invited by the company to send for bulletins and other information, or to try a barrel of them in order to prove their quality and utility.

THE WESTERN ELECTRIC COMPANY, of Chicago and New York, has recently issued a very interesting book of comparative tests of incandescent lamps, showing the economy, efficiencies in watts per candlepower, average lines of life, and a "diagrammatical illustration on the dollars and cents basis." The book also contains several handsome engravings of the lamps themselves, and one of the photometer. The pamphlet measures 12 by 14 inches, and is gotten up on heavy calendered paper, being handsomely bound in French gray stamped in blue. It is of particular interest to central station men, and will be sent to any one interested on application to the company.

THE 1901 EDITION of the hand-book "Standard Wiring" for electric light and power, by H. C. Cushing, Jr., of New York, as adopted by the fire underwriters of the United States, is now ready for delivery. This valuable little book has been entirely revised to date and has been greatly added to in the way of new and useful tables, formulæ and data. The "General Wiring Formulæ" on pages 101 to 115, for all systems of wiring, is one of the most complete and valuable additions and of inestimable value to central station men, engineers and wiremen. All wiring and construction done in accordance with the suggestions contained in this book will be passed by fire underwriters' inspectors throughout the United States.

THE DE DION-BOUTON MOTORETTE COMPANY, Brooklyn, N. Y., has recently issued a very handsome brochure advertising the fine points of the De Dion motorettes. In some features the little book is unique and in every respect it is as fine a piece of work as may be desired. The subject matter contains accounts of two long tours made by experts, one being a 1,600 mile trip over American roads and the other a 1,000-mile journey through Great Britain. Among the illustrations is included a handsome sepia half-tone road map of England, while the other cuts and pictures are done in dark green. The cover of the book is of heavy blue paper artistically stamped in deep blue with a red border, the cover being folded down three inches at the top, and the whole book bound with blue silk cord.